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GATHERING JASMINES IN THE OUTSKIRTS OF GRASSE.

PICKING ORANGE BLOSSOMS IN THE HEART OF FRANCE.

THREE TONS OF VIOLETS.

PLUCKING ROSE PETALS IN A FRENCH PERFUMERY.

ABSORPTION PROCESS

HOT MACERATION IN WATER BATHS

THE MANUFACTURE OF EXTRACTS BY WASHING PERFUMED POMADES WITH ALCOHOL.

THE MANUFACTURE OF PERFUMES IN FRANCE.

THE MANUFACTURE OF NATURAL AND ARTIFICIAL PERFUMES.*

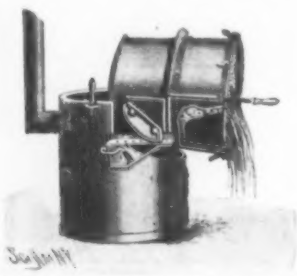
By JACQUES BOYER.

THANKS to the improvements introduced during the first half of the nineteenth century by Darcet, Leblanc, Robiquet and Chevreul, the perfume industry has developed rapidly and extensively. The reduction of the chemistry of essential oils to an exact science, and the simplification of the machinery employed, have done much for the industry, particularly in France. Recently a young French chemist, Eugène Charabot, has given an added impetus to the art through his careful study of the conditions which underlie the formation of essential oils in plants. It is largely through his interesting work that we have come to understand better how simple and ingenious is the mechanism to be found in all vegetable tissues.

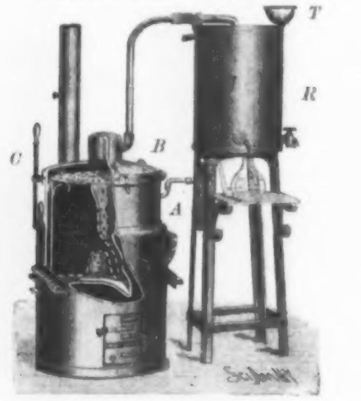
THE MANUFACTURE OF NATURAL PERFUMES.—In this brief article we shall first study the manufacture of the fragrant products to which the city of Grasse owes its worldwide fame. The preparation of all natural perfumes requires the exercise of the most delicate care. If, for example, the essence is contained in the flower, the perfume finally obtained will vary considerably with the age of the flower, with the atmospheric conditions at the time it was plucked, and with the process of extraction employed. It may happen, therefore, that instead of the exquisite aroma which is exhaled by the plant, an odor is obtained totally lacking in delicacy. No little skill, experience and knowledge are required in the art of making perfumes. Nevertheless, certain general methods are employed which may here be roughly outlined.

The process of infusion is employed for iris, musk, civet, benzoin and the like. The odorous substances are macerated with alcohol, thus forming tinctures.

The process of expression is employed to a certain extent in the making of citron, orange and bergamot



THE RETORT OF THE STILL TILTED TO DISCHARGE CONTENTS.



AN ESSENCE STILL.

perfumes. If the flowers can be gathered in abundance, the essential oil is obtained simply by squeezing the fruit with the hand. In Calabria, Italy, the expressed residue is afterward distilled with steam; but the essential oil thus extracted is of an inferior quality.

The process most widely employed is that of distillation, which is resorted to for the extraction of essences that neither a high temperature nor aqueous vapor can appreciably decompose.

Rosemary, thyme, ylang-ylang, roses, patchouli, lavender, cedarwood and sandalwood are thus treated. Long experience has shown that there are certain theoretical conditions which should obtain in practice. Among these conditions may be mentioned the picking apart of the flower to facilitate the diffusion of the essential oil; the treatment of proper quantities to obtain stronger products; distillation, gradually increased in violence by increasing the heat at the end of the process; the evacuation of the vapors with the utmost rapidity; and quick condensation. The apparatus used for the purpose of attaining these objects vary in form almost infinitely. Among the accompanying illustrations will be found a few devices which may be considered typical.

In order to prevent contact of the material treated with the walls of the retort, and in order to avoid variations in heat and accumulations of substances, a French inventor, Egrot by name, has devised a special form of retort. In a copper-plated boiler, *A*, a basket is contained, *M*, which receives the plants. In order that only the plant may project in the top of the still during ebullition, a perforated cover is employed. In order that the drippings may return automatically to the retort, it is necessary merely sufficiently to raise the refrigerant until the siphon, *B*, is set in operation. The evacuation or cleaning mechanism is easily operated by means of the reversing mechanism, *C*.

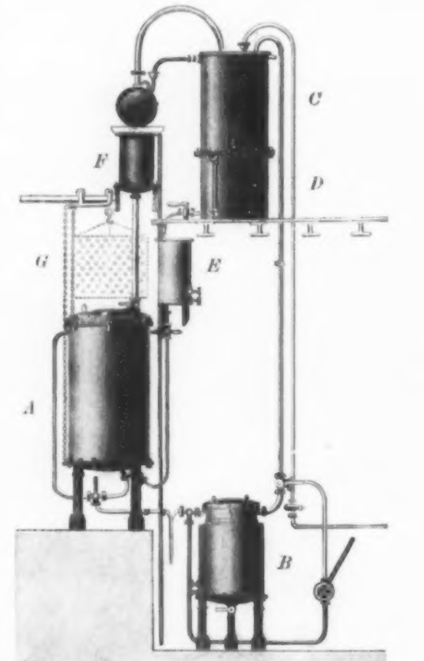
Still another general method of extracting perfumes is that of distillation, in which either fixed or volatile solvents are employed.

The use of fixed solvents depends upon the property which fatty substances have of absorbing perfumes by contact with fragrant bodies. If the cold process is employed, absorption, or *enfleurage*, as it is called by the French, is chiefly made use of for procuring the odoriferous principle of very delicate flowers. If the hot process be employed, in which case water or steam baths are used, maceration is resorted to. Either glycerine or, as is usually the case, vaseline can be employed. If a fat be employed it must be deodorized and treated to prevent its becoming rancid. For that purpose the fat of beef kidneys is made use of, mingled with hog's lard in suitable quantities. Cylinders studded with teeth and turning at different speeds grind the fats, whereupon the product is washed and rendered into vats. Odorless antiseptics are then added.

In the process of absorption or *enfleurage*, a number of shallow wooden frames about 3¼ feet long by 2½ feet wide and ½ inch deep are utilized. By means of a spatula, the fat or vaseline is spread over the bottom of each frame, or *chassis*, as the French call it. The flowers are then sprinkled or laid one by one upon the surface of the fat, where they are allowed to remain for about ten hours, after which they are removed and fresh ones substituted. The duration of the absorption process may vary from one to three days.

If oil be used, a piece of cotton fabric is employed soaked with the oil. The fabric is spread upon wired frames, on which the flowers are placed. By subjecting the fabric to great pressure, perfumed oil is extracted.

When macerated, the flowers are digested in large vessels having a capacity of about 220 to 330 pounds of fat. These vessels are heated by means of a steam or water bath to a temperature of about 65 deg. C. Women equipped with long, broad wooden palettes keep the flowers submerged until they have lost their aroma. The wilted flowers are then removed and others thrown in until the fat is completely saturated. In this manner the flowers are removed about twenty times. The entire process lasts about forty-eight



EGROT APPARATUS FOR THE EXTRACTION OF PERFUMES BY VOLATILE SOLVENTS.

hours. In this manner perfumed fats or pomades are made.

In the manufacture of extracts the flowers are treated with alcohol until the essence is entirely removed. In the manufacture of oils, flowers are placed in a large vial-like vessel, having a capacity of 15 liters, which vessel is carried on a plate to which a violent movement is given. In the making of pomades, the materials are treated in plated copper utensils, and are stirred up by dashers.

Two Parisian inventors, Egrot and Garange, have devised an apparatus for the treatment of esential oils by means of volatile solvents. The accompanying illustration shows an installation, the principal portions of which are an extracting-vessel, *A*, in which the flowers are to be treated, contained in a metallic basket, are placed; an evaporator, *B*, heated over a water or steam bath, in which evaporator the perfume is separated from the solvent by the evaporation of the latter. In the condenser, *C*, and in the reservoir, *D*, the ether, petrol, benzoin and other dissolving vapors are gathered to be used anew.

Still another process is carried out by the firm of Roure-Bertrand *fils* of Grasse. In this process the method of Milon, somewhat modified, is employed in concentrated essences. This modified process has been so far developed that it is possible to employ formerly unused substances entirely soluble in alcohol and to reduce them to their maximum concentration. By means of volatile solvents, the manufacturing firm in question is able to treat the flowers of the mimosa plant, hyacinths, narcissus, carnations and other flowers never before used in the perfumer's art. These flowers also yield solid essences which present no slight difficulties in the manufacturing process. For that reason M. Roure-Bertrand prepares solid liquid products, soluble in alcohol, the odoriferous efficiency of which is equal to that of the solid essences, weight for weight. More recently he has succeeded in obtaining absolute essences, which attracted no little attention at the Paris Exposition of 1900.

The brief space at our disposal prevents us from treating the manufacture of natural perfumes more in detail. A few statistics showing the extent of the industry may, however, not be out of place. Although most of the fragrant flowers which form the basis of natural perfumes are grown in the vicinity of Grasse, Cannes and Nice, nevertheless almost every quarter of the globe pays its floral tribute to the perfume makers of France.

The distilleries of essential oils in the department of Alpes-Maritimes use annually 5,500,000 pounds of orange blossoms; 4,400,000 pounds of roses; 440,000 pounds of jasmine; 330,000 pounds of violets; and an equal quantity of cassia and tuberoses. In Basse-Alpes, Gard, Drôme, Hérault, and Var 220,000 pounds of lavender essence; 88,000 pounds of thyme essence; 55,000 pounds of rosemary essence, and the same quantity of aspic essence are annually manufactured. Furthermore, the environs of Algiers, Staouëli, the plain of Mitidja and Boufarik (Algeria), annually send to France a contingent of 13,300,000 pounds of geraniums.

THE MANUFACTURE OF ARTIFICIAL PERFUMES.—The first synthetic perfumes were discovered by Cahours, Grimaux and Lauth; but the industry of artificial aromatic products hardly developed until the last part of the last century. The industry took its sudden rise after the remarkable synthesis of vanillin by Tiemann and Haarman. By artificial perfumes French and German chemists usually mean compounds formed entirely from artificial substances, and aromatic products obtained by the manipulation of natural essences. The methods of preparing artificial perfumes are of great theoretical simplicity; but in practice they are exceedingly difficult of application. Indeed, the principles underlying the preparation of artificial perfumes are by no means well understood. For alcohols, Haller has shown that succinct anhydrides are to be preferred. In the case of ether, the resultant alcohol is saponified and then re-etherized by means of an acid combined with the essential oil. The alkaline bisulfites are used in the treatment of aldehydes and ketones, which are separated from the compound formed by means of an acid or alkali. For the phenols, potassium is used, and the salt obtained is decomposed by means of an acid.

In this brief article it is impossible even to enumerate the perfumes which have thus far been invented. We shall therefore confine ourselves entirely to the more important ones, following the classification recently proposed by Charabot.

Among the more important nitrated derivatives, the first place should be given to the artificial musk invented by Albert Baur. This ingenious German chemist prepares his substitute for the costly natural musk by heating a mixture of isobutyl chloride and toluene with aluminium chloride. Water is added to the product of this reaction; the compound is subjected to distillation; and the distillates which pass over at a temperature between 170 and 200 deg. C. are collected. These distillates are then treated with nitric and sulphuric acid; the product is washed with water, and when treated with alcohol yields crystals having a marked odor of musk. This same characteristic odor has been encountered in many of the benzenes. The compound most widely used in commerce is the compound invented by Baur, and the ketone musk which Mallemann obtained by nitrating ketones with butyltoluene. More recently trinitro-butylxylene has been used as a substitute for natural musk.

In the series of alcohols and ethers, terpilene should be mentioned. This compound is prepared by hydrating terpenes. Terpilene is much used by perfumers, by reason of its strong odor of syringa. It is often mixed with heliotropine, the two blending well.

Among the phenols, thymol, discovered by Doveri in the essence of thyme, but also extracted from other essential oils, is of extreme importance. In obtaining this aromatic compound, the essential oil of *Ajowan ptychocis* is agitated with soda lye. The mixture is allowed to settle, and the liquor is then decanted. Employed as an antiseptic, thymol finds its chief value as an ingredient of medicinal soaps.

Vanillin is both an aldehyde and a phenol. Many ways have been devised for its preparation; but they are all more or less modifications of two methods—synthesis of benzene derivatives which are of slight scientific interest, and the oxidation of natural compounds, which is of more importance from an industrial point of view. Vanillin is employed not only by perfumers, but also by bakers and cooks, as a substitute for the vanilla of nature.

Passing by piperonal, which enters in the composition of all heliotrope perfumes, we finally reach ionone, which is obtained by condensing citral with ordinary acetone in the presence of an alkali, the resulting product being then treated by dilute acids. Ionone, by reason of its exquisite violet fragrance, is destined to become of vast importance in the perfumer's art.

In concluding this brief review, we may call attention to the influence which artificial perfumes have had upon the industry. Up to the present time it must be confessed that artificial perfumes have not curtailed the production of natural oils and pomades. At first it seemed that synthetic perfumes would result in cutting down the price of the natural product. But experience has shown that artificial essences, by reason of their coarseness, have not been able to dethrone natural perfumes in popular favor. Scientists, ingenious though they may be, have not as yet completely succeeded in reproducing the delicacy of nature. Strange as it may seem, the inventors of artificial essences have actually aided the distillers of natural perfumes, more than they have suspected. The discovery of ionone is a typical example; for according to statistics the culture of the violet has considerably increased in France ever since the introduction of its artificial rival. Ionone has proven to be a most effective complement of the feeble violet; and that may be the reason why violet perfumes are now more widely used than ever before.

* This article was written and the photographs were especially procured for the SCIENTIFIC AMERICAN SUPPLEMENT, by M. Jacques Boyer, of Paris.

ALCOHOL IN THE ARTS.*

By ROBERT GRIMSHAW.

IN a paper on denaturized alcohol read before the Hanover branch of the German Engineers' Society by Prof. Wittelshöfer, of Berlin, the importance of the industry was stated to be shown by the fact that the output in Prussia alone in 1901 was 400,000,000 liters of alcohol. In this production the Eastern provinces led; the manufacture is decreasing in the West, where only drinkable alcohol is made and by distillers only who do nothing else. In the Eastern provinces the alcohol is rectified or used as a diluent.

In the East distilling is combined with farming. Here there is rotation of crops between grain and potatoes. In many districts the potato crop has increased 33 1-3 per cent in ten years. This quantity of potatoes cannot be eaten in the province; and the potatoes cannot be sent to a distance on account of their poor quality and the high freight. Hence they must be distilled where they are produced. In the last fifteen years there came occurrences which put great difficulties in the way of disposing of all the alcohol from so great a quantity of potatoes.

In 1887 the tax on brandy was raised from 16 to 86 marks per 100 liters.† The home consumption went down, and the export was hindered by the tax laws. While in the '80's there were 80 to 100 million liters per year sent to Spain, that export is now reduced to 12 to 15 million.

It is now sought to increase the consumption of alcohol in Germany without increasing that of brandy; naturally this must be done by increasing the industrial application of the material. While in 1887-88 the consumption in the various industries was only 38,000,000 liters, in 1901 it was 112,000,000. This is rendered possible by adding 2 per cent of wood alcohol and ½ per cent of a pyridin base.

The industrial applications of alcohol are numerous. The chemical industries lead; for table vinegar there are 16 to 17 million liters per year used. Most of the alcohol is used for heating, lighting and power purposes. The oldest application is in cooking. In the new alcohol cooking lamps, some of which are regulatable, the alcohol is gasified before burning. In some the Bunsen principle is used; the alcohol before burning passing through a tube where it entrains with it the necessary quantity of air. For cooking purposes alcohol has great advantages; it is cleanly in application and instantly at disposal.

There are also alcohol heating stoves, but they are as yet too dear to come into general use.

For lighting, alcohol has only recently been used. The first incandescent alcohol lamp dates from 1895, but was not successful. The Auer lamp is better. It has 60 to 62 candle power and burns per hour about ¼ liter‡ of alcohol, but has the disadvantage of requiring a permanent gasifying flame. The Helft lamps do their gasifying without a special flame, and if kept clean and in good condition give no trouble. The cost of light is 30 per cent cheaper than with petroleum. There is, however, this objection, that it takes 1 to 1½ minutes to get the flame going.

The use of alcohol for motors is recent. Up to 1899 the difficulty was that the price varied so. Today the price is 15 marks per 100 liters delivered at any railway station in Germany; and the Alcohol Ring has a contract with 400 manufacturers not to raise this price before 1908. Experiments by Prof. Ernst Meyer show that the alcohol motor has a thermic efficiency of 39½ per cent, a result excelled by only the Diesel among motors using liquid fuel. The reason for this is that alcohol, containing as it does 8 to 9 per cent of water, permits a high grade of compression, without danger of premature ignition. As alcohol is not so rich in carbon as petroleum and benzine, it burns more cleanly. Prof. Meyer obtained from a motor of 20 effective horse power a consumption as low as 0.4 kilogrammes§ of 90 per cent alcohol with full load. Per horse power per hour this cost is 7½ pfennigs;‖ and the alcohol, with only 5,600 heat units, had to contend with petroleum which has 10,000 to 11,000.

In the discussion on the paper one member complained that his incandescent alcohol lamp smelled badly; the author of the paper said that this trouble was less than with petroleum.¶ Mr. Körting stated that the motors worked cheaply. Herr Polak stated that 100 liters of alcohol cost 24 marks. Herr Bärthl gave as the cost of fuel for the Diesel (petroleum) motor, with petroleum at 15.50 marks per 100 kilogrammes, 3½ to 4 pfennigs per hour per horse power.

THE MANUFACTURE AND USE OF BRIQUETTES IN GERMANY.

AMONG the several branches of German industry which deserve the attention of Americans by reason of their economy, their recovery or utilization of some raw material which exists unused in our country, or because they involve the most intelligent application of scientific knowledge to technical processes, may be reckoned the manufacture of briquettes from brown coal, peat, and the dust and waste of coal mines. As has been stated in previous reports of this series,** briquettes form the principal domestic fuel of Berlin and other cities and districts in Germany; they are used for locomotive and other steam firing, and are employed for heating in various processes of manufacture. For all these uses, they have three tangible advantages: They are clean and convenient to handle; they light easily and quickly, and burn with a clear, intense flame; they make practically no smoke, and are, withal, the cheapest form of fuel for most purposes.

Like most other important German industries, the briquette manufacture is controlled by a syndicate which includes among its members thirty-one firms and companies, or more than nine-tenths of all the producers in this country, and regulates the output and prices for each year. From the official report of the syndicate for 1901, which has recently appeared, it is learned that the total output during last year was 1,566,385 tons, to which is to be added the product of makers outside the syndicate, consumed at works, small retail sales, etc., making a grand total of 1,643,416 tons.

The average selling price in large quantities was 13.33 marks ($3.16) per ton, against 12.27 marks ($2.92) for the year previous, so that, notwithstanding the general relaxation of industrial activity and the diminished pressure upon the coal supply, the ruling price was the highest that had been realized since 1891. Of the 1,566,385 tons sold by the syndicate last year, 749,208 tons were taken by the German railways, 124,380 tons were sold to retailers, 497,136 tons were sold to factories and works of various kinds, and 149,089 tons, or 9.8 per cent, were used by German merchant steamers and the navy or exported to the German colonies or neighboring European countries.

The following tabulated statement shows the production, the sales of the syndicate, and the mean price per ton for the past eleven years:

Year.	Production.	Sales of Syndicate.	Price per Ton.	
	Tons.	Tons.	Marks.	
1891	482,495	202,780	12.67	$3.02
1892	533,075	516,508	10.47	2.49
1893	694,025	645,144	9.08	2.16
1894	745,414	719,258	8.82	2.10
1895	796,363	780,185	9.07	2.16
1896	830,985	818,300	9.34	2.22
1897	943,732	934,221	9.99	2.38
1898	1,078,113	1,245,269	10.22	2.43
1899	1,530,816	1,485,130	10.66	2.34
1900	1,563,928	1,519,811	12.27	2.92
1901	1,566,385	1,560,230	13.33	3.17

The syndicate produces to a large extent briquettes made from coal screenings, which require a matrix or binder of some plastic, inflammable material, and for this purpose 116,956 tons of mineral pitch were used, which cost on an average about $10.25 per ton, delivered.

It need hardly be said that the general use of briquettes for domestic fuel in a large, densely-built city, as well as for generating steam in a number of electric generating plants and factories, must have a decided and beneficial influence in reducing the smoke, which in most American cities has become a persistent and oppressive nuisance. Berlin, although a busy manufacturing city, ranks as one of the cleanest and best kept in Europe. One of the first things usually noticed by American and English travelers visiting the German capital for the first time is the absence of that cloud of dusty smoke that overhangs so many towns and cities in our country. The reason for this lies in three facts: The preponderant use of coke and briquettes, which are practically smokeless; the skillful scientific construction of boiler furnaces and chimneys; and, finally, the high standard of skill that is taught and enforced among firemen who stoke furnaces with coal for steam and manufacturing purposes. It is not every strapping laborer who can shovel coal who is permitted to stoke a boiler furnace in this country. Before he can assume such a charge he must be taught the theory and practice of economical, scientific firing, by which the coal is distributed in such manner and quantity over the grate surface as to secure the most perfect combustion of its volatile elements. The Silesian coal used here in most large steam plants and factories is rich in bitumen and would rank below many of the bituminous coals of the United States, and yet the long, dense, trailing clouds of smoke from mill and factory chimneys which are so familiar a sight in many American cities are rarely seen in this section of Germany, where the indiscriminate shoveling of raw bituminous coal into the steam and other furnaces is considered an ignorant and wasteful proceeding.

Coke making in retort ovens, by which every element is saved and bituminous coal converted into smokeless coke and gas, is another important factor in German fuel economy and abatement of the smoke nuisance. If American municipalities beyond the economic range of anthracite are ever emancipated from their present vassalage to the smoke incubus, it will be through the enforced use of one or more of three forms of prepared fuel, viz., coke and fuel gas made in closed ovens from bituminous coal, and briquettes made from lignite, peat and other inferior materials by processes which have been invented, tested and proven to be efficient by the older and more economical countries of Europe.

THE CHEMISTRY OF THE PROTECTION OF STEEL AGAINST RUST AND FIRE BY CONCRETE.

THE newspapers have commented with considerable alarm upon the prediction recently made by Gen. Wm. Sooy Smith, M. Am. Soc. C.E., of Chicago, that the modern steel skeleton building would prove to be a short-lived structure owing to the inadequacy of a covering of concrete to protect the steel from rust. Among engineers it has been considered generally that no more efficient a protective covering for steel than concrete could be had. All past experience has supported this belief, which is based, besides, on chemical and physical laws that have at least sound reasoning as their foundation. These laws have recently been summarized by Prof. Spencer B. Newberry,* and in view of the wide interest attracted by Gen. Smith's alarming prediction, we quote the portions of this summary which bear most directly upon the question raised by that well-known Chicago engineer:

There are two important respects in which steel construction gains by the addition of concrete. These are protection against rust and protection against injury by fire. Leaving the engineering aspects of the question to those far more competent to discuss them, I ask your attention for a few minutes to a brief consideration of the chemical and physical laws by which this protection from rust and fire is assured.

The rusting of iron consists in oxidation of the metal to the condition of hydrated oxide. It does not take place at ordinary temperatures, in dry air, or in moist air free from carbonic acid. The combined action of moisture and carbonic acid is necessary. Ferrous carbonate is first formed; this is at once oxidized to ferric oxide, and the liberated carbon dioxide acts on a fresh portion of metal. Once started, the corrosion proceeds rapidly, perhaps on account of galvanic action between the oxide and the metal. Water holding carbonic acid in solution, even if free from oxygen, acts as an acid, and rapidly attacks iron. In lime water or soda solution the metal remains bright. The action of cement in preventing rust is now apparent. Portland cement contains about 63 per cent lime. By the action of water it is converted into a crystalline mass of hydrated calcium silicate and calcium hydrate. In hardening it rapidly absorbs carbonic acid and becomes coated on the surface with a film of carbonate. Cement mortar thus acts as an efficient protector of iron, and captures and imprisons every carbonic acid molecule that threatens to attack the metal. The action is therefore not due to the exclusion of air, and even though the concrete be porous, and not in contact with the metal at all points, it will still filter out and neutralize the acid and prevent its corrosive effect.

Opportunity to determine the condition of steel embedded in concrete after years of exposure to air and moisture is seldom obtained. In all cases, however, in which such work has been taken up and examined the metal has been found bright and free from corrosion, and all who have witnessed the tests agree that the preservation of the steel is remarkable. A striking example of this is found in the inspection of a cement and steel water main on the Monier system at Grenoble, France. This main was laid in 1886, and consisted of cement pipes 12 inches inside diameter, 1 3-5 inches thick, containing a steel framework formed of 30 ¼-inch rods surrounded by an outer spiral ¼ inch and inclosing an inner spiral 1-6 inch in diameter. The spirals and rods were bound together by knots of iron wire. On February 2, 1901, three lengths of this pipe, which had lain 15 years in damp ground, were taken up in the presence of a number of officials and engineers, who certified to the results of the inspection. The tubes showed no cracks, and the adhesion of the cement mortar to the iron was so firm that it could be loosened only by strong hammering; on striking with a heavy hammer the tubes gave out a musical tone like cast-iron. The metal showed no trace of oxidation; even the wire knots were absolutely free from rust.

On March 13, 1901, the Prussian Minister of Public Works investigated the condition of the concrete-steel retaining wall on the Oberstrasse, Berlin, built in 1890. On breaking away the concrete at many points the iron was found entirely free from corrosion.

In No. 7 of "Expanded Metal Doings" is to be found the testimony of a large number of American engineers and architects as to the results of their inspection of steel after several years' protection by concrete. All agree that the preservation of the metal is most satisfactory. Mr. James Christie, of the Pencoyd Iron Works, reports as follows:

"We have had several opportunities to examine iron that had been embedded in cement concrete for periods varying from five to ten years. I have never seen a case where any appearance of corrosion existed. In fact, the preservative effect was always in evidence. In one instance the bases of angle iron posts were in a situation damp and slightly acidulated. These were effectually protected by a casing of cement. . . . We have recently applied a wash coat of cement to exposed surfaces of girders. I will let you know the result after some time has elapsed."

Regarding the use of Portland cement as paint for iron work, the following notes may be of interest:

According to La Revue Technique, cement paint is largely used by the railway companies of France to protect the iron work of bridges from rust and corrosion of steam and sulphurous gases from locomotives. The iron is brushed with leather brooms, dampened, and given two coats of liquid cement and sand.

At Zeebrugge, in Belgium, steel piles are cleaned by sand-blast and coated with semi-fluid cement mortar applied by compressed air.

In a discussion on concrete-steel construction before the American Society of Civil Engineers, June, 1898, Mr. Corydon T. Purdy stated that the engineers of the Boston Subway, after investigation and careful tests, adopted Portland cement paint for the protection of the steel beams of the structure.

Dr. Goslich, at the 1901 meeting of the German Portland Cement Manufacturers' Association, stated that iron spirit tanks, painted on the inside with Portland cement, are universally employed in European distilleries. The adhesion is increased by allowing the metal to become rusty before applying the cement paint, and perfect protection from further rusting is secured. Cement plastering is also largely used in this country to protect the inner surface of steel saltpans and sulphite digesters from the corrosive action of the hot solutions with which they are filled. In the same way that Portland cement, from its alkaline nature, neutralizes and fixes carbonic acid, so it protects iron from the attacks of other dilute acids, such as the sulphurous and sulphuric acid contained in the products of combustion of coal. The fear has sometimes been expressed that cinder concrete would prove injurious to iron, on account of the sulphur contained in the cinders. The amount of this sulphur is, however, extremely small. Not finding any definite figures on this point, I determined the sulphur contained in an average sample of cinders from Pittsburg coal. The coal in its raw state contains rather a high percentage of sulphur, about 1.5 per cent. The cinders proved to contain only 0.61 per cent sulphur. This amount is quite insignificant, and even if all oxidized to sulphuric acid it would at once be taken up and neutralized in concrete by the cement present, and could by no possibility attack the iron.

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* Specially written for the SCIENTIFIC AMERICAN SUPPLEMENT.

† 1 Liter = 1.0568 U. S quarts = 0.2642 U. S. gallon.

‡ 1.06 pint.

§ 0.55 pounds avoirdupois.

‖ 1.78 ½ cents U. S. currency.

¶ This is a fact, if the Russian petroleum which is largely used in Germany is meant; our American product has no such sulfurous smell.

** Advance Sheets No. 1142; Consular Reports No. 254.

* A paper read before the annual meeting of the Associated Expanded Metal Companies at Chicago, Ill.

These considerations and examples show clearly that no anxiety need be felt in regard to the durability of steel embedded in concrete, even when exposed to the most trying conditions that can occur in practice.

The fire-resisting qualities of cement may be said to be a comparatively new discovery, one of the many unexpected practical applications of this valuable material which the past few years have revealed. It is well known that Portland cement is practically infusible, and that the water with which it combines in hardening is given off very slowly under the action of heat. The surprising feature of its behavior when strongly heated is that it does not crumble, crack, warp or scale off, as most other materials do. Even after long calcination at high temperature it still shows considerable cohesion and adhesion to metal, resists the impact of powerful streams of water, and does not crack under sudden cooling. On moistening with water after ignition it again hardens. Even if this last property be found unavailable for practical purposes, yet concrete exposed to fire and water is easily replaced, and its purpose is fulfilled if it protects from injury the steel work upon which the safety of the building depends.

The two principal sources from which cement concrete derives its capacity to resist fire and prevent its transference to steel are its combined water and porosity. Portland cement takes up in hardening a variable amount of water, depending on surrounding conditions. In a dense briquette of neat cement the combined water may reach 12 per cent. A mixture of cement with three parts sand will take up water to the amount of about 18 per cent of the cement contained. This water is chemically combined, and not given off at the boiling point. On heating, a part of the water goes off at about 500 deg. F., but the dehydration is not complete until 900 deg. F. is reached. This vaporization of water absorbs heat, and keeps the mass for a long time at comparatively low temperature. A steel beam or column embedded in concrete is thus cooled by the volatilization of water in the surrounding cement. The principle is the same as in the use of crystallized alum in the casings of fire-proof safes; natural hydraulic cement is largely used in safes for the same purpose.

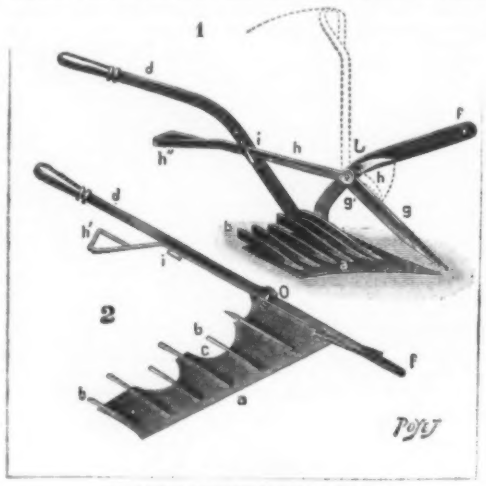
The porosity of concrete also offers great resistance to the passage of heat. Air is a poor conductor, and it is well known that an air space is a most efficient protection against conduction. Porous substances, such as asbestos, mineral wool, etc., are always used as heat insulating material. For the same reason cinder concrete, being highly porous, is a much better non-conductor than a dense concrete made of sand and gravel or stone, and has the added advantage of lightness. In a fire the outside of the concrete may reach a high temperature, but the heat only slowly and imperfectly penetrates the mass, and reaches the steel so gradually that it is carried off by the metal as fast as it is supplied.

The thickness of concrete required to prevent injury to metal structures is more or less a matter of conjecture, based on observation of the results of fire. Mr. Wm. Parker, in a discussion before the American Society of Civil Engineers, June 26, 1901, states that practically no experiments on this point are on record. In his opinion the maximum depth to which concrete is liable to injury in fire is 1½ inches, and this only in case of very intense heat and impact of powerful streams of water. A depth of 2 inches he considers sufficient to insure against possible serious injury. There is great need of careful experiments to determine the temperatures reached by steel beams protected by concrete coatings of varying thickness, and exposed for varying periods to heat of measured intensity. Such experiments could be carried out with little difficulty, and would form the basis for the establishment of exact rules for safe practice which would guarantee the protection of steel structures from temperatures liable to cause warping or undue strains due to expansion.

A NEW PLOW FOR VINEYARDS.*

ALL experts are unanimous in recognizing the necessity of applying manifold cultural operations to the grapevine. By exercising due care the viticulturist will keep the vine in a proper state of vegetation and assure himself a maximum production of fruit. The results sought will be attained provided the soil be aerated and maintained in a constant state of fertility, and all adventitious vegetation on the surface be destroyed.

Although plowing produces very good results, it would prove inadequate for bringing about the complete extermination of parasitic plants were its action not supplemented by harrowings, weedings and second dressings. Hence the necessity of the vine grower's possessing a certain number of implements, especially plows, harrows and hoes, and of his performing several distinct agricultural operations which are often onerous and consume a good part of his time.



A NEW VINEYARD PLOW.

1. Elevation. 2. Plan.

Struck by such inconveniences, M. Julius Salomon has been led to construct a very ingenious plow, which seems to be destined to render valuable services in wine countries. This plow, which is called "La Française," is designed to effect three operations: To plow the soil to a depth of about four inches, to destroy all parasitic plants, and to break up the clods and level the earth as would be done by a vigorous harrowing. It is needless to dwell upon the method of hauling, which does not differ from that employed for the various models of vineyard plows. The principal point is to bring into prominence the original features of the implement, which is analogous, as a whole, to a plow with a single handle.

In its essential part, "La Française" consists of a cutting plate, *a* (Figs. 1 and 2), forming an angle of 54 deg. with the axis of the plow. To this plate, which is prolonged in the rear into an inclined plane and constitutes, in a manner, the first portion of a mold-board, are secured knives, *b*, designed to cut the earth that passes across them into a series of partial prisms. The posterior part of the plate, *a*, is provided with concave portions, *c*, through which the crumbled earth immediately falls, while all the earth lifted by the inclined plane undergoes the action of the dividing knives. These latter have a wider spacing behind than in front, and the result is that the partial prisms are expanded and broken up the farther they advance upon the inclined plane, while at the same time the forward movement of the plow projects the earth at a velocity dependent upon the speed of the draught animals. As a consequence of this thorough breaking up of the plowed earth, the phenomena of aeration and oxidation are intensified; the surface layer is more energetically mellowed, thus checking the action of capillarity; and the earth preserves its entire freshness.

This new plow has likewise a pronounced action in the destruction of noxious weeds. The swath cut and laid horizontally by the share is taken up by the piece performing the part of a mold-board and is divided thereon and submitted to the expanding and projecting motions already mentioned. The roots of the plants carried along with it are freed from their earth and deposited upon the surface of the mellow soil, where they soon dry up exactly as if they had been cut by a hoe and divided by a harrow.

Finally, the colter of the apparatus has a special form and purpose. It is designed primarily to cut the earth vertically. Its upper part, *g′* (Fig. 1), forms the counter-blade of a cutter of which the part, *h′*, secured to a lever, *h*, terminating in a handle *h″*, is movable around the point, *o*. The object of this instrument is, while the plow is in motion, to cut the weeds that happen to accumulate in the angle formed by the colter and beam of the plow. Ordinarily, the lever, *h*, rests in a support fixed to the plow handle, *d*. If the plowman sees fit to cause the cutter to act, he can operate it without changing his position and without losing sight of the direction of his plow and horse. This part of the implement, however, seems to be entirely useless, since in well conducted vineyards weeds are never abundant enough to form serious obstructions, and, moreover, the majority of the present vineyard plows are not provided with a colter. The manufacturer of "La Française" has understood this perfectly since he has not fixed the cutter thereto permanently, but has provided a very simple device to permit of its removal in a few minutes when the dearth of weeds renders the use of it unnecessary. After having been cut by the knives, *b*, the earth, completely disintegrated, falls flat in the rear of the plow and gives the illusion of ground leveled by the harrow.

Upon the whole the implement under consideration, while producing manifold effects, greatly reduces the cost of labor.

* Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from La Nature.

HOLDEN'S MOTOR BICYCLE.*

WE are enabled to present herewith some illustrations of the ingenious motor bicycle invented by Col. Holden, to which we referred in an article on the Crystal Palace Motor Car Show, which appeared in our issue of February 21 last, page 185. Of the drawings, Fig. 1 represents a side elevation of the machine; Figs. 2 and 3, sectional elevation and plan of the motor; Figs. 4 and 5, a vertical section of the mixing valve and the mixture indicator respectively; Fig. 6, a sec-

* The Engineer.

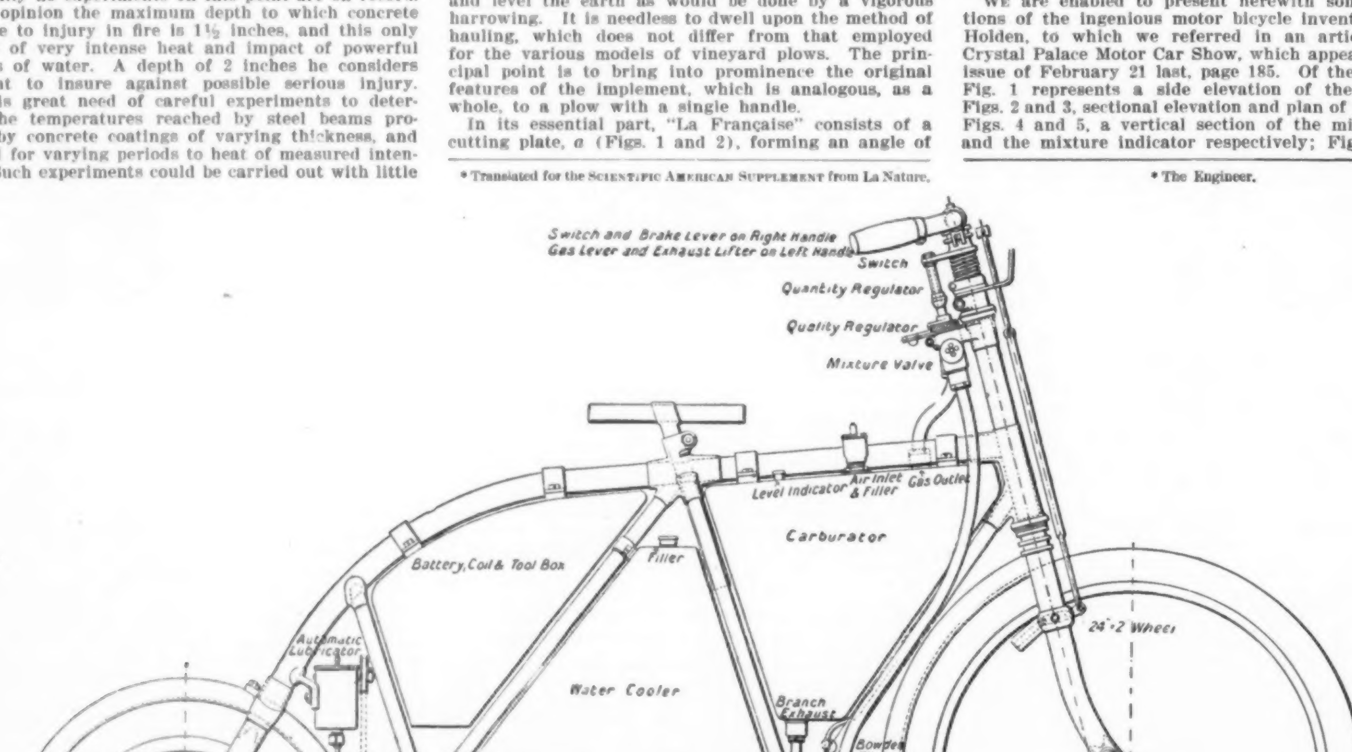


FIG. 1.—SIDE ELEVATION.

PETROL MOTOR BICYCLE.

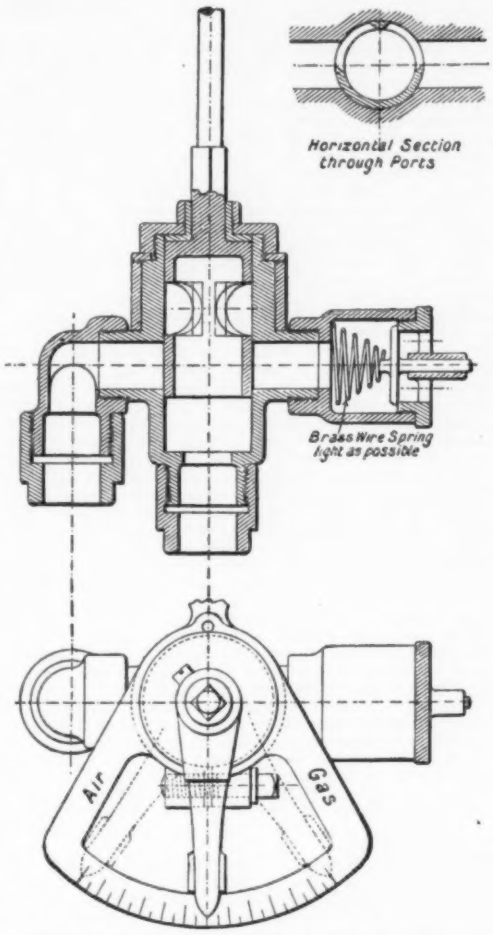
tional view of the switch in the handle-bar. The motor is capable of indicating about 3 brake horse power at the comparatively low speed of 750 revolutions per minute, and the cylinders are water-cooled. Although there are practically four of these, each pair of cylinders being in the same straight line on either side of the machine, forms a double-ended single cylinder, open in the middle, but with a continuous water jacket. The cylinders are steel tubes, on which brass water jackets are brazed, the edges of the free ends of the jackets being turned down sufficiently thin to form a concertina joint, to allow for expansion and contraction. The back end of each pair of cylinders is inclosed by cast-iron covers, which are braced together by tie rods, two above and one below, which also serve to secure the motor to the frame of the bicycle. The exhaust and admission valves are disposed neatly in the casting, the exhaust valve on top and the admission valve below. The lift of the latter is limited by the bottom of the exhaust valve. The exhaust valves are opened successively by a rocking lever shown. This can be operated when desired by the rider by means of a Bowden wire, so as to enable the valves to be opened while running, say downhill, or when starting. The half-speed shaft is driven by worm gearing, the worm wheel being worked by a bent lever from the connecting-rod. Though this method of operating the half-speed shaft does not give a perfectly uniform speed of rotation, the slight defect does not affect the driving. The exhaust gases pass from the cylinder to a flattened box below the engine, from which they pass, partly to the carbureter and partly to the atmosphere. A branch pipe also serves to conduct some of the hot gases through the vaporizer, whence they return to the exhaust box. There is a slight back pressure in the box, which reduces the noise of the exhaust.

The connecting-rods are attached rigidly to pins which pass horizontally through a hole at the middle of the piston. The other ends of the rods are connected to the cranks on the rear wheel by means of universal joints, to allow of their slight outward deformation due to stress. The electric ignition system has been well thought out. It is of the induction coil type, the coil working with a trembler, its primary circuit being made and broken four times during two revolutions of the engine by a double cam mounted on the axle of the rear wheel of the bicycle, making contact with a spring attached to a block of insulating material on the fork. The high-tension distributing arrangement is mounted on the forward end of the half-speed shaft—Figs. 1 and 2. A collar of insulating material is mounted on the end of this shaft, and revolves inside an annular ebonite box. On this boss of insulating material is mounted a wire brush in conducting connection with a center stud. Five insulated leading-in wires are brought in through caps of ebonite. Four of these wires terminate in concentric curved metal plates, adapted to be brushed by the revolving brush. The fifth makes contact with a vertical metallic arm which rubs on the metal stud to which the revolving brush is electrically connected. The leading-in wire connected with this vertical arm, and in permanent electrical connection therefore with the rotating brush, is connected with one high-tension terminal of the coil, the other being earthed. Each of the four other insulated leading-in wires leads to the sparking plugs in each of the four cylinders, which are therefore put consecutively into connection with the insulated high-tension terminal of the induction coil. No sparking, however, can take place inside the high-tension distributor, as the primary circuit is only closed through the contacts on the rear axle slightly after the revolving brush is in contact with each of the curved plates, and is broken slightly before it leaves it. It will be understood that the two cams on the rear wheel axle, revolving at twice the pace that the brush carried by the half-speed shaft revolves, make the necessary number of contacts in the required time. The switch in the primary circuit for cutting off the electric ignition is arranged in the right handle bar—see Fig. 6.

The air inlet valve for the carbureter—Fig. 1—is kept normally closed by a spring, which is overcome by the suction of the pistons in the engine. The pressure in the carbureter is thus always somewhat less than that of the atmosphere, a condition which is claimed to facilitate vaporization. The valve opens into a downtake tube with lateral orifices covered with copper gauze. The carburized air delivery tube is a flat tube arranged horizontally inside the top of the carbureter, with lateral openings also covered with copper gauze, and additionally protected against splashing by perforated copper plates. The air is led from the delivery tube of the carbureter by a flexible pipe to the mixing valve—Fig. 4—arranged just behind the head of the bicycle. The air comes up through the passage on the left and enters through the slightly-loaded valve on the right. A central sleeve is connected with the indicator visible in Fig. 1. This sleeve has lateral openings, and can also be displaced vertically by a lever on the handle bar of the bicycle. When the pointer shown in Fig. 5 is in the middle, the proportions of air and carburized air admitted are equal. If it is turned more to the left, more air goes in, while if turned to the right, more gas. The total amount of mixture admitted depends on the vertical position of the sleeve, so that by raising it the engine can be gradually throttled. From the mixing valve the mixture passes down a flexible tube to a distributing tube arranged underneath the engine and between it and the exhaust box.

A positive system of lubrication is provided. The lubricator—Fig. 1—is shown in front of the rear wheel, and is provided with an external pulley driven from the half-speed shaft. This imparts motion to a chain inside the lubricator, which carries up oil over the top of a vertical funnel, down which it drips along a wire, and is conducted to the parts requiring lubrication.

The bicycle is the invention of Col. Holden, but we believe that Mr. H. Parsons, of the Motor Traction Company, Limited, Walnut Tree-walk, Kennington, the builders, has had much to do with the perfection of the details. Originally the machine was provided with pedals on the front wheel, but these have now been dispensed with, having been found unnecessary. Steps are provided on either side for the feet of the rider.



FIGS. 4 AND 5.—MIXING VALVE AND MIXTURE INDICATOR.

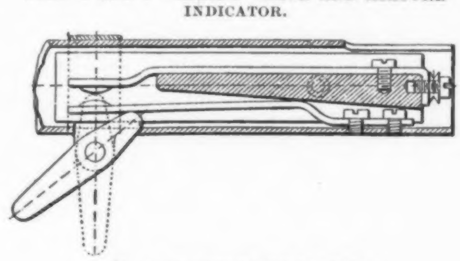
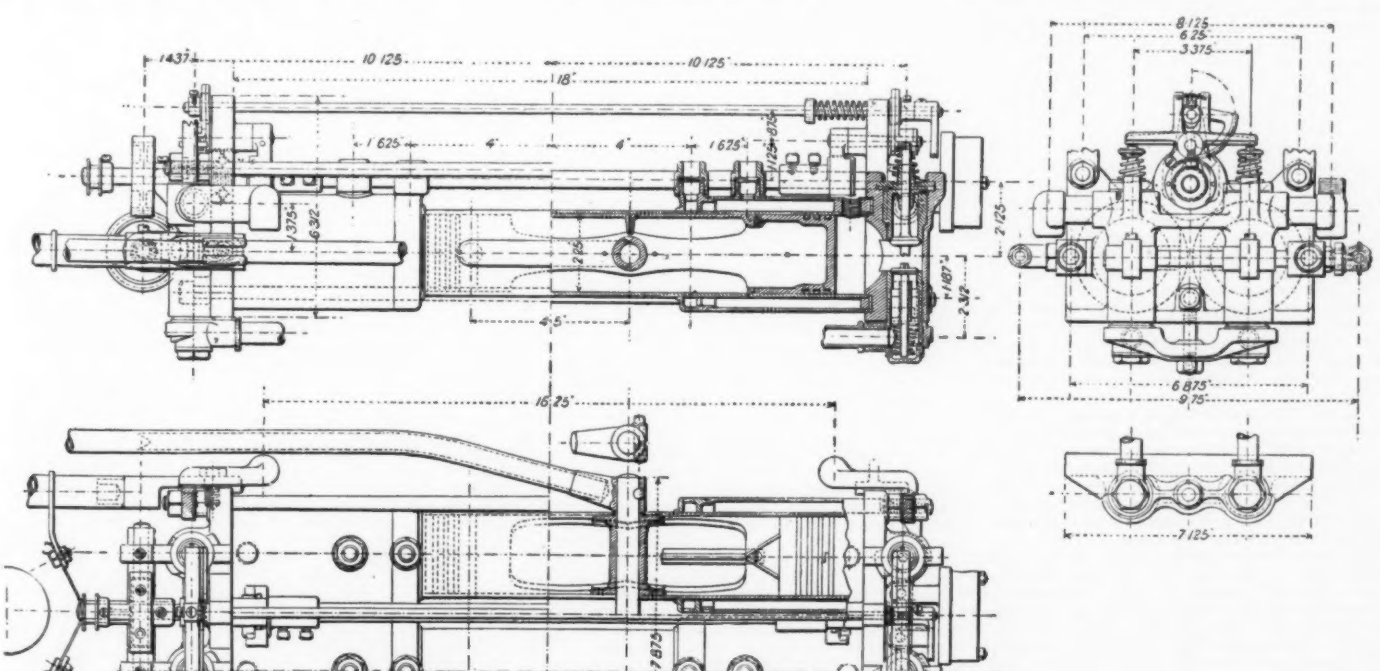


FIG. 6.—HANDLE-BAR SWITCH.

A NEW LOCOMOTIVE VALVE.

At the meeting of the Mechanical Engineers of Great Britain, held at Newcastle, England, a new locomotive valve, devised by Mr. Walter M. Smith, an engineer of Gateshead, was described by the inventor. Prior to the year 1887 piston valves had been tried experimentally in locomotive engines, but without much success, and the experiment invariably resulted in the piston valve being discarded. In 1888 Mr. Smith produced a satisfactory piston valve, and a compound passenger engine was built fitted with the appliance. The engine had two cylinders, the high pressure being 18 inches in diameter and the low pressure 26 inches in diameter, the length of stroke in each case being 24 inches. One valve 7 inches in diameter was used for the high pressure and two valves 5½ inches for the low-pressure cylinders, the latter valves being placed side by side and actuated by one rod connected to each of the valve spindles. In 1891 a goods engine was fitted with cylinders and valves of the same size and form with the exception that steam was admitted by the ends of the valves instead of at the center of the valves, as in the previous case. A considerable saving in coal was effected by this engine when compared with other locomotives of the same construction working in the same link. But this is not the only advantage which such a system possesses. The contrivance is also of such a character that there is a reduction of the amount of power absorbed in friction in the valves and valve motion; because the power so



FIGS. 2 AND 3.—SECTIONAL ELEVATION AND PLAN OF MOTOR.

PETROL MOTOR BICYCLE.

gained is utilized in producing extra work, the simplicity of the general arrangement of cylinders and valve motion also tending to reduce the cost of and time occupied during repairs. Eleven engines with slide valves ran each an average of 18,277 miles and consumed 35.27 pounds of coal per mile. An engine with piston valves ran 20,329 miles and consumed 32.05 pounds of coal. This was 1.6 pound less than the lowest of the slide valves, and 3.22 pounds less than the average, equal to a saving of 9.1 per cent. These facts, together with other advantages made the subject generally of considerable interest and importance and one worthy of further and careful study; the result of the same ending in the invention of an entirely new form of valve. In 1899 a new type of express passenger engine was designed and built at Gateshead. It started to work in August and ran 139,543 miles up to December 31, 1901, without any appreciable wear in the valves or valve motion. The valves were taken out and sent to the works for examination, and were replaced by a duplicate set of valves, the segments and rings being made of cast iron. On the first journey the engine went from Newcastle to Edinburgh, 124½ miles, at an average speed of 51 miles per hour without a stop, returning to Newcastle the same morning; and afterward went to Leeds and back on the same day, and has since continued to perform these journeys. The average mileage for each month was 10,822. The engine was worked by a double shift of men. The total number of miles run from the time it left the shops up to the 30th of June, 1902, was 204,475 miles. To run heavy long distance express trains with ordinary cast iron slide valves direct from the planing or grinding machine involves considerable risk. By the end of January, 1900, ten engines fitted with piston valves were at work and they had worked as efficiently as the experimental engine. At the end of May, 1902, twenty additional engines were at work. These thirty engines have done better work and cost less for repairs than any other type of engine doing similar work. The total number of engines fitted with the combined form of circular and relief valve for the North-Eastern Railway is eighty-six, and thirty more are in course of construction. The cost of the new form of cylinders and valves has been compared with that of the ordinary cylinders and valves and the difference is very slight. An engine designed with a piston valve, however, will haul a 25 per cent greater load than is possible with a slide valve with the same consumption of coal.

THE ROMAN GALLEYS OF LAKE NEMI.*

When, from the top of one of the surrounding hills, one's glance sounds the clear waters of Lake Nemi, one perceives a mass of confused forms, with rounded contours and indistinct lines, and divines that they are drowned objects sleeping there from the times of the grandeur of Rome in the crystal liquid of the "Speculum Dianæ." They are lying there patiently in their dress of seaweed and mosses until the indolent posterity of the conquerors of the world pluck them from their repose to ask them to throw light on that departed civilization which has left them there.

In fact, this volcanic shell with its luxuriant vegetation, this placid and somber lake, sleeping in the midst of the thick and encircling forests, this amphitheater of hills, these almost perpendicular gradins covered with bushy trees through which, here and there, penetrate imposing cliff fronts burned by the sun, this oval lake of Nemi, is, in a word, one of the corners of Latium where there is still vigorous the memory of the glorious age of Rome; and it is a veritable amphitheater whence, at times, there appears to ascend a mysterious influence. Ilex and chestnut crowd together on the banks, like spectators motionless on the gradins through waiting centuries; in a corner below the village, the orchards flower in the spring time with the thousand rose-tinted stars of peach trees, the white constellations of the apple trees, and these gay tints cut across the melancholy green of the trees as in the Roman circuses the podium of the vestals must have stood out athwart the pressing and vulgar crowd of spectators. Here is a flagged path over which, in former times, the litters of the Roman matrons used to pass in going to consult the Oracle of Diana, for this lake, these forests and these mute cliffs, the thick shadows and lively colors of this countryside were only the crown of the temple of the goddess of the woods and chase; it is here that the dynasty of autocrats, who formed the veritable expression of the limitless power and frightful wealth of the Roman Empire, at the same time that they condensed in themselves all the faults and vices which brought about its decadence, used to come to enjoy a spectacle of which nature had borne all the cost. Sumptuous villas once lined the shores of the lake and rose stage over stage above the surrounding slopes; treasures of art came hither demanding a framework from this incomparable landscape; the very water cradled palaces and floating temples.

When the pitiless decadence, the barbarous fatality broke the last energies of the Latin world, everything here fell into ruin, was destroyed and rotted away, forgotten, buried under the fertile soil or beneath the placid waves. It only needs to remove this earth, to sound with one's eyes these sleeping waters, to discover the remains of an epoch, its spolia opima, its rich objects and its imperishable souvenirs.

Museums have been enriched with findings which have been made in the environs of Lake Nemi. Beneath the slime and under the moss, treasures have already been found; but what was not the surprise of the world of artists and savants when it was announced, a few years ago, that two floating houses had been seen sleeping a few meters beneath the water's surface, and with what impatience were attempts made to bring them to dry land!

You were probably informed of this occurrence at the time, as well as of the discovery of certain artistic bronzes belonging to the mysterious ship sunk to the bottom of the "Speculum Dianæ." But difficulties without number speedily presented themselves, which caused the abandonment of the attempt to save these ships; silence would doubtless have fallen definitely upon the matter in spite of the great interest in it, if, recently, one of the engineers who had a share in the first researches had not been overcome with remorse because of so complete an act of forgetfulness and had not once more brought forward the matter of the galleys of Nemi, and suggested a new scheme for bringing about their salvage, a system which offered far less difficulty than those which had been attempted earlier under the impulse of feverish impatience.

I hasten to tell you that there is some chance that a decisive effort may be attempted to recover these rich relics which I mention; riches of inestimable artistic worth; for, apart from their rare sumptuousness, these floating houses surely represent a marvel, unique, which stands out from among all those memorials of our ancestors which up to this day we have discovered. This is not a palace, a temple, a public building, it is not a new example of Roman architecture, but it is a unique specimen of Roman naval art. Our king, Victor Emmanuel III., has just examined the scheme which would allow, as I have just told you, the bringing of these ships to dry land. He has shown himself disposed to accept the patronage of the committee which has this end in view. For the rest, here is a short description of what this new scheme is:

Until now the investigations have been carried on by divers who have studied the positions and dimensions of the two ships, and all that has been discovered has been owing to their efforts. But one fact has been discovered which made the saving of the ships almost impossible without lowering the level of the whole lake, and this fact is that they are in a large part buried in the mud, which has, as it were, riveted them to the place where they sank. Now a sufficient lowering of the level of the lake presented almost insurmountable difficulties; so, for the moment, they were about to renounce all hope, if a new discovery had not turned up a short time ago which completely changed the situation. The lake of Nemi, like its neighbor, the Lago Albano, both inclosed in ancient craters, has an outlet pierced in the flank of the hillside which allows the overflow of its waters. You doubtless know under what historic circumstances, during the siege of Veii, the outlet of Lake Albanus was pierced; as to that of the lake of Nemi, there is the most complete ignorance as to its origin. But now we know that it is of a comparatively recent date, for another outlet, at a lower level, and still in good condition, has been discovered. It would be sufficient, then, to remove the matter which obstructs this ancient outlet, and, in parenthesis, besides the fact that in this way the two Roman ships could be saved, one could at the same time dry off the site of the ruins of the villa which Julius Cæsar had built on the shores of Lacus Nemorensis, and which were covered by water after the level of the lake had been raised by the change in the level of the outlet.

A tradition prevailing among the inhabitants of the village of Nemi, built almost perpendicularly above the lake, has always maintained that Roman galleys did exist beneath the waves. One circumstance confirmed this popular notion and the legends which prevailed for centuries, and that is that fishermen casting their nets to take the delicate fish which breed in quantities at the bottom of the lake have often had to abandon the attempt to bring their prey to the surface because the nets became entangled among obstacles which at first were of an unknown character. It was, therefore, approximately known about what spot in the lake must be sounded in order to discover these ships, for there was only one obstacle which could exist at such a place. Sometimes, moreover, bits of rotten wood were torn away and brought to the surface.

About the middle of the fifteenth century Cardinal Prospero Colonna, Lord of Nemi and Genzano, two villages staged one above the other upon the hillsides which surround the lake, had had his imagination impressed by the tales which were current among the peasants; the legend, according to which the relics of the richness of the Roman emperors were rotting beneath the waters, seemed to him all the less ridiculous because he was so thoroughly versed in Greek and Latin letters and the arts; consequently, he would not have been at all unwilling to have his name attached to an enterprise which might assure him an imperishable glory. It may be remarked in passing that as for these sentiments, although anyone of reasonable intelligence might hold them to-day, they were at that time really meritorious, for then the cult of antiquity was hardly in fashion or held in honor; the noble monuments of Rome had undergone numberless vicissitudes without finding in the popes and the lords of the aristocracy friends anxious to preserve for posterity these precious relics; the tomb of Cecilia Metella, the theater of Marcellus, the Colosseum, the baths, the mausoleums, all that the barbarians had respected, were no more than fortresses about which the princes waged wars whose bloody struggles discolored Rome; and when peace followed the civil wars of the Middle Ages, every ancient edifice was held to be merely a quarry from which anyone, provided he was strong enough, could carry away bits of stone to build his dwelling, statues to decorate his palace and columns to adorn his churches. In short, this was the time when the Palazzo Farnese was built, and the Barberini and Cancelleria, and so many others, out of stone coming from the Colosseum, times when they overthrew a pagan temple in order with its precious marble columns to ornament a Catholic church.

Unfortunately, Cardinal Colonna, in spite of his wealth and learning, had not the means and apparatus adapted for so difficult a piece of salvage as that of the galleys of the lake of Nemi. He had to content himself with bringing from Genoa sailors of miraculous cleverness, capable, as it appears, of living beneath the water for minutes at a time, and swimming like veritable fishes. These past masters in the art of diving set themselves at work and were not long before they definitely proved the existence of two large sunken ships. They even tried to save some portions of them, but we cannot too much felicitate ourselves that their efforts were not pushed with perseverance, for their means and methods were of the most primitive kinds. They dove to the bottom and fastened to the wood of the structures which they wished to raise great iron hooks made fast to ropes operated from the surface. One portion of the prow of one of the galleys, however, gave way and was brought to the bank.

All the wise men of science and letters in Rome and Pope Pius II. himself, hastened incontinently to the place. An author of the time has transmitted to us a recital of the astonishment which this learned assembly exhibited before such a "find" and a description of the bit of the prow plucked from the ship. "It was composed," says he, "of big planks, three inches thick, of the wood named larchwood; it was covered all over with a good coating of yellow or purple, and upon this were fixed with thick bronze, not iron, nails a large number of leaden plates."

Another discovery of the time was that of the leaden pipes which brought to the ships fresh water from neighboring springs. It was understood from these things that one was really in the presence of two floating houses, two lacustral palaces rather than simple galleys; and these leaden pipes bore inscriptions from which could be deduced that which tradition already affirmed; that is to say, that these submerged dwellings had been built by Tiberius. All these objects were disposed of, we now do not know how or where; they have never been rediscovered in our time.

A century later another attempt was made. A certain Francesco de Marchi, a Bolognese soldier, this time himself descended to the bottom of the lake, using one of the rudimentary instruments which allowed him to breathe for a certain length of time under water. We don't know quite what this instrument was, for De Marchi left only an incomplete description of it, in which he simply said that the invention was due to Maitre François de Lorraine, and that the latter had made him swear never to reveal to anyone by what mechanism the renewing of the air was effected.

De Marchi details his discoveries at length, but it seems to be plain from his tale that he made only a single descent of any length of time—an hour—during which he bound together and had pulled to the surface a large quantity of beams and planks of cypress wood and pine. He said that he saw great iron rails eaten by rust, small bronze nails which fixed leaden plaques over the bottom, and brought away portions of the brick floor, three spans wide in each direction and four inches thick, also another portion of flooring of a beautiful red enamel. He also saw chambers in the interior of the ship, and leaden pipes, but nothing of what he brought to dry land remained, for robbers, thinking that they were stealing the secret of his submarine machine, carried away everything.

Another spell of silence, this time lasting for three centuries. But tradition was not going to abandon its belief after the experiments which we have spoken of had proved the existence of the vessels, whether they were built by Tiberius or by some other emperor.

Finally, on the 10th of September, 1827, Chevalier Annesio Fusconi made a new attempt. He employed a diving bell invented by Dr. Halley, and this instrument stood for an immense advance, since eight workmen could work at the same time, receiving air through a pump placed on a raft above. This is how Fusconi tells the success of that day's work:

"The workmen descended in the diving bell, and after a short time gave the signal agreed upon; we pulled them up, and they brought us, amid the unanimous applause of those present at the operation, bricks framed in iron with the inscription 'T I B. C A E S, and several metal nails." Later success did not give the lie to this first descent. "We did the same things on the following days up to the 28th of this month, a date at which a round metal object, which the workmen could never properly describe, was made fast to be pulled to the surface, but the ropes gave way."

But once more the robbers appeared, for, during the winter, the investigations were suspended, and they seized the apparatus of the unfortunate Fusconi. Let us pity the misfortune of this generous man who had paid out of his own pocket 30,000 francs for the construction of his machines. But it must be agreed that the proverb "Misfortune is good for something" has some truth in it, seeing that Fusconi, in his ignorance, proposed simply to draw the vessels from the water bit by bit, believing that it was impossible to recover them whole. The objects which he had discovered were those which his predecessors had seen: bits of wood, nails, leaden pipes, and, moreover, a bronze capital, marble tablets, a fragment of grillework bearing the inscription "T I B. C A E S," and forty large bricks of terracotta, two of which were framed in iron, as were those described by De Marchi. Fusconi also said that his workmen saw at the bottom of the lake statues, columns and metal beams which could not be drawn out of the water because the cables would not stand the weight and broke during the operation.

A large portion of the objects recovered at this time were purchased for the Academy of St. Luke by Cardinal Camerlingue.

* * * * * * * * * *

All that precedes relates to efforts made in the time of the government of the popes to save the Roman galleys, but the great political changes took place after 1827, the time of Fusconi's explorations, and new obstacles were created, while science considerably minimized those obstacles which caused the failure of the attempts made up to that time.

The rights of the state in artistic treasures have been recognized for a long time; the Pacca edict against the exportation of anything which might have the character of a work of art was the first affirmation of these rights and dates from the commencement of the nineteenth century. Later, when Italy was organized as a single kingdom, the régime of objects of art was definitely fixed, always in a manner favorable to the state. This brought it about that every private attempt at saving the Roman galleys encountered insurmountable obstacles. The state claimed its rights in any objects which might be discovered, hindered all speculation in their value, and especially prevented their exportation. No one, therefore, was inclined to cast into the water enormous sums for the good pleasure of the Italian government, who, on its side, is generally thinking of other things than archæology. On the other hand, the lake of Nemi is private property, one of the fees of the very ancient patrician house of

* H. Mereu in the American Architect.

the Orsini, and this fact made it impossible that anyone should undertake to investigate the galleys without the authorization of Prince Orsini.

In any other country, let us say in passing, both government and prince would perhaps have been rivals in their ardor for the recovery of the Roman ships, if it were only for the sake of having their names attached to an enterprise capable of making its author forever celebrated; but here it was quite otherwise. In 1895 a Roman antiquary was making some excavations in the neighborhood of the lake and particularly on the very site of the famous Temple of Diana and had the idea—which may have been suggested to him—of seeking by skillful sounding the exact position of the galleys, with the hope of saving at least some parts of them. He entered into a contract with the Orsini family in which he bound himself to attempt at his own risk and peril the necessary researches, and had them begun at once by a diver at the point indicated by tradition and the earlier explorers as that where the Roman galleys had been rotting for centuries.

The results of these attempts are known; it was an unexpected revelation, a very thunderclap. Much was spoken at that time about the marvelous bronzes of Lake Nemi, and especially of the bronze head of Medusa, a piece which far exceeded all that anyone had hoped for in the way of the splendors of these floating palaces. How many artists of the Renaissance, even the greatest ones, would have been happy to sign their names to such a morsel! This head is treated with great skill; the beauty of Medusa is heightened by the expression of atrocious suffering which she endures; the artist who created the bronze profoundly realized the misfortunes of this mythical personage and the terrible power which the gods granted to her as chastisement for her faults and pride.

The archæologists were equally interested in the bits of enameled work and vitrified compositions which evidently belonged to mosaic floors. This mosaic work seemed to form an "opus sectile," that is to say, a pavement composed of marbles of different colors, cut in shapeless pieces of regular size fitting one against another, so that when everything was in place designs and figures of the most beautiful effect were produced. This rich "pavimentum" is more beautiful and richer than those famous ones which are found in the palace of Caligula on the Palatine.

Such was the success of the investigations carried on about the first galley. But the existence of a second one could not be doubted because of the attempts made in the earlier centuries, so they came upon new discoveries, the most important of which was a bronze hand resting upon a plaque of the same metal and which was apparently a "manus averrunca," that is to say, an amulet against bad luck, which was ordinarily placed at the stern of ships to attract favors and the protection of Fortune. This "manus averrunca" must have belonged to an epoch earlier than that of the bronzes of the first galley; it is by the rigidity of the forms and the harsh lines of the fingers that the archaic character of the bronze is recognized.

But the Italian government, fearing that the antiquary who had undertaken the partial salvage of the ship might do damage in his attempts to get hold of some of the objects of value, laid an injunction on him, and ordered that an official inquest should be held to study above everything the position and the dimensions of the galleys in order that later they might determine the most practicable way of raising the vessels from the water. The inquest, which was intrusted to a naval officer and some divers from the government arsenals, gave the best results and the most exact data: the first galley is 20 meters from the bank; its length is 64 meters, its breadth 20; the stern is at a depth of 5.3 meters; the prow is lower, being 12 meters below the surface; the broadside has given away about the center for a length of 3.4 meters. The second galley lies 50 meters from the bank; its length is about 71 meters, its width 24.4; its stern lies at a depth of 16.6 meters, and the prow pitches toward the center of the lake to a depth of 22 meters. This galley has given away for a length of 2 meters on the starboard side. The distance between the two galleys, from center to center, is about 200 meters.

It must be noticed that these investigations have had to be carried out on a steeply inclined bottom, since there is a difference of about seventeen meters between the stern of the first galley and the prow of the second, and there is some apparent probability that a certain number of the ornaments, furniture and utensils which were aboard may have slipped down to still greater depths. The hulls of the galleys, as I have said above, are not entirely free; the first is almost wholly submerged in mud and slime; there is only the upper portion of the deck which is free. A deck seems to start from the stern, which has a peculiar form like a fan, toward the center of the ship. The second hull emerges from the mud for a length of about forty meters, but the stern is completely covered; the interior, however, seems empty.

The manner in which these galleys were built, a manner which caused the liveliest wonder among the first divers, deserves to be briefly described. Planking is fixed to the framing by copper nails; they are lapped and held in place by long bolts; moreover, they are made fast on the inside by pins of resinous wood. The planking is covered with a compact cement over which is stretched some thick woolen stuff. And, finally, everything is protected by the plates of lead which we have mentioned.

Now let us turn to the methods which might be used in the salvage of these vessels. There are two distinct methods: First, the absolute hoisting of the vessels from the water, and, secondly, the lowering of the level of the lake. The first method would be preferable; for the lake of Nemi being one of the most picturesque in Italy, affording a landscape of extremest beauty, that artists and foreigners who come to Rome hardly ever miss visiting, it would be a great pity to remove one of its decorative features, this little pool of tranquil water, the "Speculum Dianæ," which really forms its chiefest ornament. But for the system of direct hoisting, it would be necessary to construct a small city on rafts above the vessels and clean away in some degree the bottom of the lake in order to remove the mud, and then, possibly, slide ropes under the hulls and set in motion cranes of great power. And this presents a very grave inconvenience. Almost all of the objects of art which used to form the riches of these galleys have slipped out of the hulls and now lie buried in the slimy mud at the bottom. One would run great risk, therefore, of withdrawing from the water only the carcasses of the galleys, to say nothing of the difficulty of saving them whole. The engineers could not gather a very exact idea of their position and the force of the resistance which would be opposed to the cranes, and the least error in the distribution of the strain, which ought to be regulated according to the weight of that portion of the ship to which it is actually applied, might compromise the outcome of the enterprise.

They are thinking of making a decisive attempt which may be crowned with the most startling success because there has been discovered, as I said above, an outlet at a lower level than that through which to-day the lake discharges its overflow, and which is in a better condition. This is Roman work, a long tunnel with a considerable section, measuring 1.6 meters by 1 meter. All that would have to be done would be to clean away obstructions and through the cleared outlet the level of the lake could be lowered by 9 meters. Then they would build at its mouth the short arm of a siphon, dipping below the water, and through it successive layers of water, which still covers the floating houses of Tiberius, could be sucked out of the ancient crater.

As you see, this scheme is fairly practicable. The cost of the undertaking would not be enormous, and what would be a very great advantage, and practically the one condition under which these famous vessels can be saved, is that the work would be done, as it were, on dry land.

This is what they are undertaking to carry out, a campaign which has long been the dream of Italian and foreign archæologists, and it would be very helpful if the king should decide to accept the patronage of the committee which is going to be formed. He is young and bold, and has already given proof of a high degree of erudition. He cannot fail to be interested in the events we here speak of.

Already there is talk of erecting a Roman naval museum where might be deposited these Roman barques and all the ornaments and rigging which might be recovered. This would be one more attraction for Rome, and one can feel certain that it would be carried out with care and intelligence, for although in Italy things are undertaken with considerable sloth, yet, when they are undertaken, they are carried out properly.

SKETCHING THE CHARACTERISTIC FEATURES OF ROCKS.

THE aim of a geological artist in making a geological sketch is to bring out the distinctive geological characters of the rocks, and even emphasize and specialize these characters more forcibly than they may actually appear in nature, without doing violence to truth and the picturesque character of the scene. Up along the side of the mountain he sees a few feet of Cambrian quartzite outcropping; then there is an interval, perhaps of several hundred feet, covered by detritus, and then another outcrop along the same line of dip; these he can now connect, and he may put in or omit as much of the covering of detritus as suits him. His main object is to show that a stratum or series of Cambrian quartzites forms the base of the mountain, resting on massive granite. Higher up he sees peeping out here and there from similar detritus covering, patches of thin bedded Silurian limestone, and above that a bold, unobstructed cliff of massive blue limestone, capped with a soft talus slope revealing here and there a black shale, and this again is overlain by a well-defined wall of dark grayish green columnar rock, he knows at sight to be porphyry. And then a heavy mass more or less rounded on the edges, and more or less jointed, he knows to be conglomerate, and a finer, more regular bed above, sandstone. On top of this is the usual cap of glacial wash or drift, soft and rounded in outline, with trees and vegetation growing on it.

Although to the casual observer, rocks may all seem much alike, yet to the geologist and to the average miner or prospector many of them are very distinct; have strong peculiarities, varying as much as one variety of tree from another. Some of these may be recognized even at considerable distance. As an obvious example, a bed of shale is easily distinguished, even at a distance, from a thick layer of massive sandstone. From this broad example, by observation we may become quite acute in recognizing even at a distance, different varieties of rock, especially in a neighborhood we know well and with whose rocks we have had experience either as a prospector or a geologist. After a few experiences, however, he can generally recognize, even at a distance, the rocks he proposes to draw. Some of the guides are geological position and sequence, color and form. Looking at the section of a mountain he assumes that the massive lowest rock forming the basement of the mountain can hardly be anything else from its geological position, color and appearance than fundamental granite. Then as regards sequence, he expects that the lowest sedimentary rock resting on this will be the lowest in the geological scale, viz., the Cambrian (though this does not always follow). Assuming it to be Cambrian, he looks out for the characteristic features of the Cambrian, viz., a hard white, or rusty brown, or banded quartzite, with a remarkable brick-like or masonry-like structure, and numerous joints like the courses of bricks in a building. Satisfied that these are Cambrian quartzites, he draws them pretty much as he sees them, giving some emphasis to their brick-like courses or masonry-like structure.

A soft bed above these hard, vitreous rocks, which is partly eroded out and makes a dent in the profile is, he conjectures, a band of softer shale or slate and draws accordingly. Having done with the Cambrian, the next bed above or series of beds is of a rugged, thin bedded gray rock, which should hold the next place in order, viz., the Silurian limestone. He draws the beds in rough, ragged lines, such as characterize this limestone when erosion has eaten away the softer lime from the ragged edges of the hard, cherty nodules. Next above the Silurian should come, in geological order, the Devonian, but this in the Rockies is rarely represented unless a bed of quartzite some 20 to 40 feet may represent it. This so-called parting quartzite, be recognizes by its white or rusty color and its compactness and brick-like courses. The next bed is the massive blue-gray limestone of the lower Carboniferous. This is easily recognized by its massiveness and by its joint planes, often worn into narrow fissures or caverns by water; the limestone, too, is full of holes, both small and big, and its rugged, fretted outline and cavernous character easily distinguishes it.

This is capped by an intrusive sheet of porphyry whose columnar form as well as greenish gray color indicate the class of rock to which it belongs. A soft bed of shale above this is indicated by its being eroded into on the edges, or presenting a soft talus slope. The conglomerate and sandstone above are shown by the rounded outlines of the former and the even jointing character of the latter.

The surface drift matter of pebbles and sand forming the top of the hill shows its character by pebbles here and there peeping out from the turf; by the smooth outline the formation gives and by the growth of timber and vegetation on it.

The feeding dike coming up from the granite below and cutting across all the formations is readily detected by its forming a narrow wall up through the formations if harder than they, or sometimes a shallow crevice, trench, or groove when the dike is of softer or more oxidizable materials, and is eroded below the surface of the other rocks through which it passes.

Similarly, the quartz, feldspathic, or pegmatitic veins in the granite below may stand up above the surface in strong relief, or be eroded into narrow trenches or depressions.

Besides geological position and sequence, color and form are considerable aids, as are also varying degrees of softness and hardness in the succession of rocks. You will observe how the hard rocks like the quartzites stand out on the profile, while the softer rocks, like the shale and to a certain extent the soluble limestones, recede and are eroded back and make a hollow in the profile. Almost every individual class of rock has its distinctive feature or mode of weathering or decaying which often even more than its color, enables the geologic artist to recognize its form at a distance.

Thus, massive granite generally "weathers" in huge rounded forms, bosses and masses; schist, in sharp, needle-like peaks or serrated ridges. The eruptive rocks, such as rhyolite and diorite are apt to weather in a series of pinnacles like those of a Gothic cathedral. Intrusive sheets of eruptive rock and lava-flows like basalt commonly weather in the columnar form composing their structure and may look at a distance like a row of palings or stockades. Basaltic dikes on cross-sections often weather in peculiar spheroidal forms showing a concentric structure.

Andesitic breccia weathers in huge rounded masses and is often cut up into curious mushroom-like monuments by erosion.

The sedimentary rocks, too, have their peculiar features and forms of weathering and erosion. Limestone, especially, if impure and carrying much chert or flint is channeled into exceedingly rugged, rough forms; it is also full of caverns, enlarged joints and holes.

Conglomerate sandstone is commonly eroded into large rounded masses with large open joints and cavernous recesses. Sandstone is more regular, and compact, and more evenly jointed. Slates and shales and marls are generally worn back under the more massive rocks or else present smooth talus slopes or benches.

In drawing uptilted, sedimentary strata such as hog-backs along the body of a mountain range, the hardest rocks make or cap the most prominent ridges. The softer rocks are either eroded into valleys or make smooth slopes. A dike of eruptive rock like basalt is often eroded into a steep cone or butte with steep, even slopes on either side, the top capped by a wall of lava. The soft strata of the prairie are thrown into billowy, soft, swelling outlines, eroded here and there by a river cutting through them. Experience will soon enable the geologic artist to form a shrewd guess of the nature of the rocks in the scene from their appearance and form, even at a distance.—Prof. A. Lakes, in Mines and Minerals.

ARGENTINA'S WHEAT CROP.

ABOUT four years ago, Sir William Crookes, England's famous physicist, said that not later than 1931 the world's wheat areas would be exhausted. That Sir William was sharply rapped over the knuckles for this statement by economists, goes without saying. He showed conclusively enough that the Canadian province of Athabasca for more than 125 miles west of its eastern boundary, was an extension to the north of the wheat soil of Manitoba. The climate favored wheat culture into Athabasca. Crookes thought that the capacity of Australia was greatly exaggerated, but the British authorities quickly came to the fore and proved that 50,000,000 acres of good land were still uncultivated in Queensland alone.

The sinister view which Crookes took of South America's possibilities has been more recently brightened by a book published in Leipsic, bearing the title "Landwirtschaft und Kolonisation im Spanischen Amerika." According to its author, Mr. Kaerger, only 1-60 of the surface of Argentina is under cultivation. That the great fields of wheat and maize and the vast pasture grounds are to be found chiefly to the east, is to be attributed to the fact that Argentina holds business relations with the rest of the world, principally through the ports of Buenos Ayres and Rosario. Perhaps a more pertinent reason is to be found in the humidity of the region; for the western provinces require more or less irrigation before they can be brought under cultivation. According to Mr. Kaerger, the eastern limit of the Argentina wheat culture without irrigation will be the frontier between Argentina and Uruguay. This frontier will be followed to a point between the provinces of Entre Rios and Corrientes. The northern boundary of unirrigated wheat land will follow the line of mean annual precipitation of one meter to the west till it meets the annual isotherm of 21 degrees. The western bound-

ary will pass southeast through the province of Cordoba to Villa Mercedes in the province of San Luis. The southern limit will be a line connecting the Villa Mercedes with the Atlantic Ocean somewhere south of the city of Buenos Ayres. From this it would follow that the great wheat area would include the whole of Entre Rios, nearly all of Santa Fé, a portion of Corrientes, the east of Cordoba and the northern part of Buenos Ayres. Within this territory the available wheat land has an area of 157,000,000 acres. If Mr. Kaerger's prophecy be correct, Argentina can produce at least twenty-four times as much grain as she is now growing.

AUTOMATIC RELAY TRANSLATION FOR LONG SUBMARINE CABLES.*

By S. G. BROWN.

THE system of relay working for long submarine telegraph cables here described must not be looked upon as being in an experimental stage. It is in everyday use on some of the lines of the largest cable companies, notably of those of the Eastern Telegraph Company, their station at Gibraltar having been the first to be fitted up for automatically translating cable messages between Porthcurnow in England and Alexandria in Egypt.

The usual methods employed on cables at the present time is to receive signals on a strip of paper, written by a siphon recorder, as a dotted ink line. The message at an intermediate station is then punched by hand on another strip of paper, which strip is passed through an automatic transmitter for retransmission over the next line. Or, if the speed of signaling and the conditions of the circuit will allow of it, the message is read off the siphon recorder strip by the clerk, direct, as it flows from the instrument, and sent on by a hand-key, signal by signal. This latter system is termed "human translation," the speed being necessarily limited by the possible rate of hand transmission, and it is slow, laborious and permissible at only one station. A cable relay is, therefore, valuable in that it replaces the clerk in all these operations, receiving and sending on the traffic automatically, whatever may be the speed of transmission. I believe the provision of a submarine cable relay has been one of the problems, to the solution of which the attention of telegraph engineers has been turned for some years. The requirements in such an instrument are great sensitiveness, combined with the capability of being worked at a high speed by the feeble forces available at the receiving end of a long cable, and the absolute assurance of perfect contact. With the exceedingly feeble current obtainable at the end of cables, when operated at their present working speed on the siphon recorder, it is useless to bring two pieces of metal into "butt" contact with the view of closing the circuit of a battery, so as to work, say, a post office relay, since the resistance of such a contact may be normally many thousands of ohms, while, if the local battery is increased so as to break down this resistance, the contact on passing a current coheres or sticks together and prevents the cable current from opening the circuit. This disturbing force, although a great drawback in sensitive relays, has been effectually made use of for purposes of wireless telegraphy.

Varley, in his patent No. 3,456 of 1862, proposes to get over the difficulty of the relay contact sticking after the passage of the current by revolving the contact pieces, but I have found by actual experiment that such a movement actually increases the trouble of making contact, so that, on the whole, the remedy is as bad as the disease. I have found, however, that with such a form of relay, the resistance of the contact could be reduced by the use of a suitable short-circuiting condenser.

About the early part of the year 1899 I discovered that good electrical contact could be made and maintained by keeping the end of the relay tongue pressed upon the surface of a divided plate, and that frictional resistance to side motion of the tongue could be reduced and almost eliminated by moving the plate under the tongue, or what amounts to the same thing, by moving the tongue over the surface of the plate, the movement in each case being maintained in the direction of the length of the tongue. To obtain the best effect and greatest sensitiveness, the relay tongue is arranged in practice to move across the surface of a rotary drum, the drum is divided into insulated sections, and the sections joined to post office or similar relays. This relay is called the "drum cable relay."

In Fig. 1, *a* is a recorder coil suspended in the field of the permanent magnet, *M*; *f* is a light suspended frame to carry the relay tongue, *p*; the frame is joined to the suspended coil, *a*, by two silk or quartz fibers. The pointer, *p*, is a fine siphon glass tube carrying through its bore a phosphor-bronze wire. This wire is soldered to an iridium tip, which tip is shellacked to the extreme end of the siphon tube. The iridium tip bears lightly upon the surface of the drum, *D*, which is kept revolving at about 150 revolutions per minute. The drum, *D*, is made in three parts: the two outer ones, *d' d''*, constitute the "dot" and "dash"-marking surfaces, and the middle one, upon and in the center of which the pointer normally rests when no signal or current passes, is insulated. When the tongue is deflected by the movement of the coil to form, say, a dot, a circuit is made through the battery, *b*, the tongue, *p*, and the post office relay, *R'*. A movement of the tongue in the opposite direction would close the circuit of the post office relay, *R''*.

The relay depends for its efficiency upon the reduction of frictional resistance to the lateral movements of the tongue, and it is easy to prove that this effect is due to the tangential motion of the surface, for if the drum is stopped when signals are being received, the tongue also comes at once to rest, since the currents leaving the cable are of insufficient strength to overcome the statical friction between tongue and surface. This principle is somewhat ignored, I am afraid, in most treatises on friction; might there not be a parallelogram of friction corresponding to that which we use in dealing with force and motion?

S' S'' are condensers of 2 microfarads capacity each, used to short-circuit the sliding contact between the tongue, *p*, and the drum, *d*. Without them, good electrical contact can only be maintained when the surfaces of the drum and the tongue are very much cleaner than they can possibly be kept in practice. Why these condensers do improve the contact, making the contact practically perfect, I am not prepared to say. One eminent electrician maintains that this proves the existence of a vibratory contact. We all know why a condenser improves a vibratory contact, but I hardly think this touches the root of the matter, because I find that when the surface of the drum is exceptionally smooth the value of the condenser is usually more pronounced.

K is the receiving condenser. This condenser is placed in the circuit to act as a curb to the signals and to block out earth currents. The current from the cable, *c*, passes through this condenser before flowing round the suspended coil, *a*, to the earth plate, *E*. The placing of the condenser, *K*, in the circuit introduces a difficulty due to its becoming charged under a succession of signals of the same polarity, producing what is termed "variable zero." This variability of zero which, unless special means are provided for its

PLATE 1.—"DRUM" CABLE RELAY.

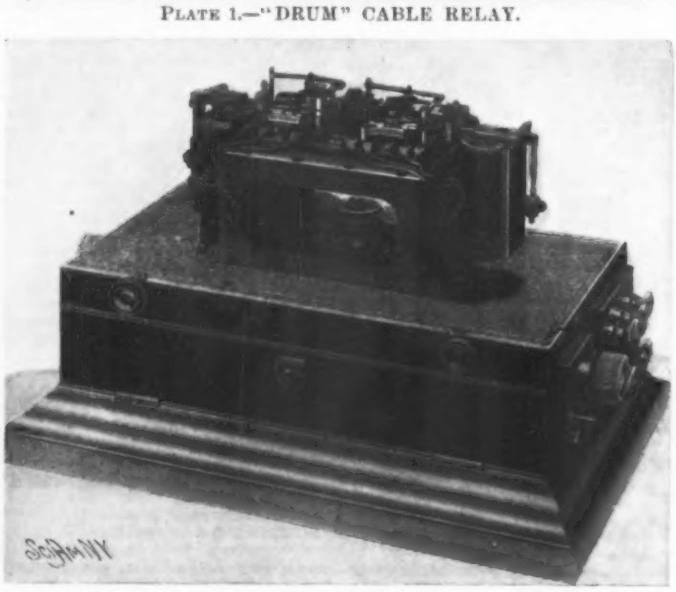


PLATE 2.—INTERPOLATOR.

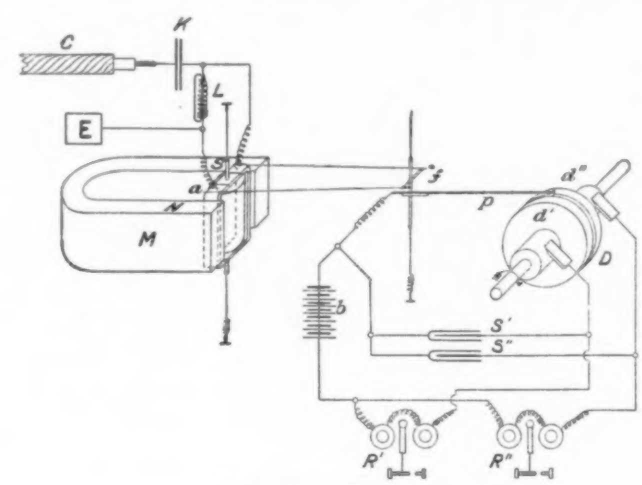


FIG. 1.—(See also Plate 1.)

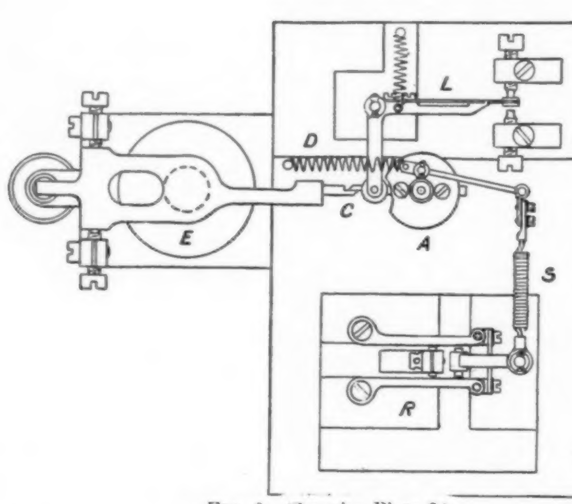


FIG. 2.—(See also Plate 2.)

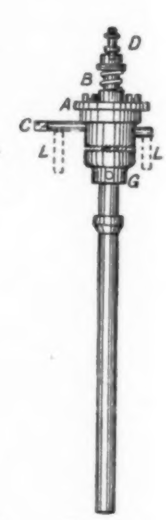


FIG. 3.

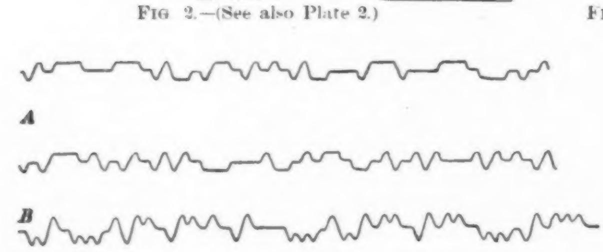


FIG. 4.

* Paper read before Institution of Electrical Engineers.

elimination, always occurs in cable signals when receiving condensers are employed, is of little or no importance if the siphon recorder is used as the receiving instrument, but is fatal to the working of a relay of any form.

While experimenting with Mr. A. L. Dearlove at Porthcurnow on the Gibraltar-Porthcurnow cable of the Eastern Telegraph Company, the variability was got rid of by placing a high-resistance shunt across the receiving and transmitting condensers, but this method was not found quite practical owing to the fact that earth-currents were not entirely excluded by the shunted condensers. The consequence was that the earth-current temporarily upset the adjustment of the relay, and this mode of working was objected to by the company. For this reason I devised another method, which in practice has been found entirely satisfactory. I shall explain it here as briefly as possible.

"Variable zero" may be got rid of by means of "local correction," that is to say, a current from a local battery and the relay, *R′ R″*, is sent through a circuit having considerable retardation made up of a condenser placed between two high resistances, condenser and resistances being capable of minute adjustment. The relays, *R′ R″*, produce the same order or combination of signals as that charging up the condenser, *K*. As the current from the cable, due to this choking action of the condenser, dies away, so at exactly the same rate does the current from the local correction circuit increase. The correction current flows through a separate winding on the suspended coil, *a*, in the same direction as the signals, so as to compensate for the loss of current from the cable, thus eliminating "variable zero" disturbances entirely from the working of the relay.

L is a magnetic or inductive shunt of 30 ohms resistance, joined across the terminals of the suspended coil, *a*. The shunt can be adjusted to suit cables of from 1 to 10 K.R.; the largest size at present used has a very high self-induction. I am not at present prepared to say what the value is. It is secured by the use of many thousands of turns of copper wire, and a heavy closed magnetic circuit. The mechanical arrangement of this shunt is on the lines of the well-known "Mordey" transformer.

Roughly speaking, to get high inductance to deal with the slow changes of current from a cable, we must have weight. Our largest shunt turns the balance at something like three hundredweight. When operated by the cable currents from the end of a line, the iron of the shunt must be magnetized only in its initial stage, the molecules being magnetically strained well within their elastic limit. In support of this statement, I shall refer you to Prof. Ewing's book on "Magnetic Induction in Iron and Other Metals," chapter vi., from which the following is more or less a quotation.

Lord Rayleigh in testing magnetometrically a bar of iron, one end of the iron being very near the magnetometer, and with a compensating coil adjusted to balance the magnetism, which a feeble magnetizing current induced in the bar, found that the compensation remained perfect if the magnetic force fell below 0.00004 C. G. S. Within this range of force there is no retentiveness. The magnetizing process begins like the straining of a solid body with an elastic stage, within which there is no permanent set. Some electricians have thought that there must be a drawback to the use of iron in these shunts, especially as the iron forms a closed circuit. They have suggested air as being a more perfect material, but I think the above well meets their objection. The permeability of the iron of these inductive shunts when used for cable work is probably somewhere about 150 as against the 1,200, or thereabout, when used as transformers for alternating-current lighting work, the permeability of air being 1.

Magnetic shunts have been designed, so that the molecules of iron may be shaken up by an alternating-current excitation. This alternating-current circuit is disposed so that there shall be no interaction between it and the shunt-winding. The permeability of the iron may thus be greatly increased. The method has been tried with satisfactory results. These magnetic shunts are of very great value in cable work, for they steady and curb the action of the relay coil, and without them relay working would be well-nigh impossible. Their action on a siphon recorder is no less marked: using a "plain" automatic or hand-key as sender, they produce curbed signals, and this with an increase of speed.

The drum cable relay apparatus, so far as I have described it, is all that is necessary for simple translation on short cables, a hand-key being used at the first station, the relays, *R′ R″*, being connected to work two sounders, which sounders are joined up with a battery, in the same way as a hand-key, to transmit the messages over the second line; but in what follows I shall assume that at the originating station an "automatic transmitter" is employed.

Although scarcely necessary, it may be well here to call attention to the fact that when a cable is worked at its highest practicable speed, many of the originating impulses are obliterated from the received signals whenever successive impulses of the same polarity or

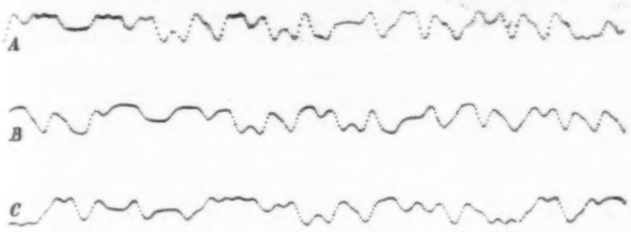


FIG. 5

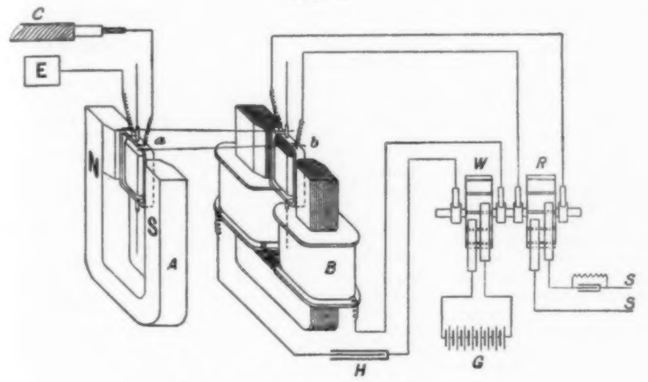


FIG. 6.—(See also Plate 4.)

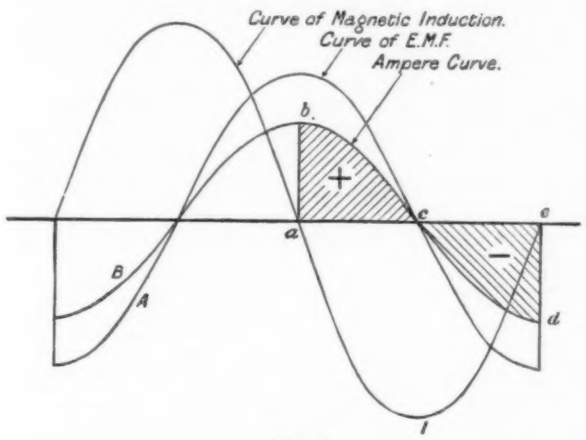


FIG. 7.

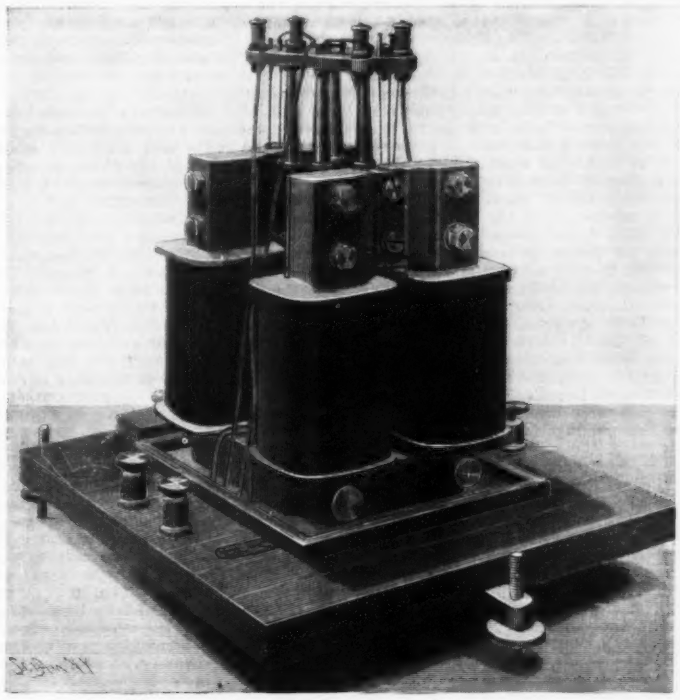


PLATE 4.—MAGNIFYING RELAY.

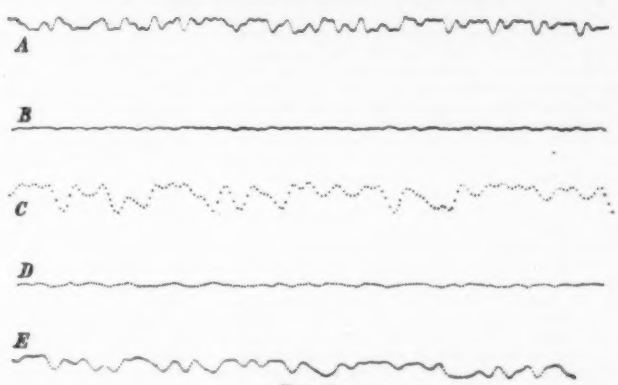


FIG. 8.

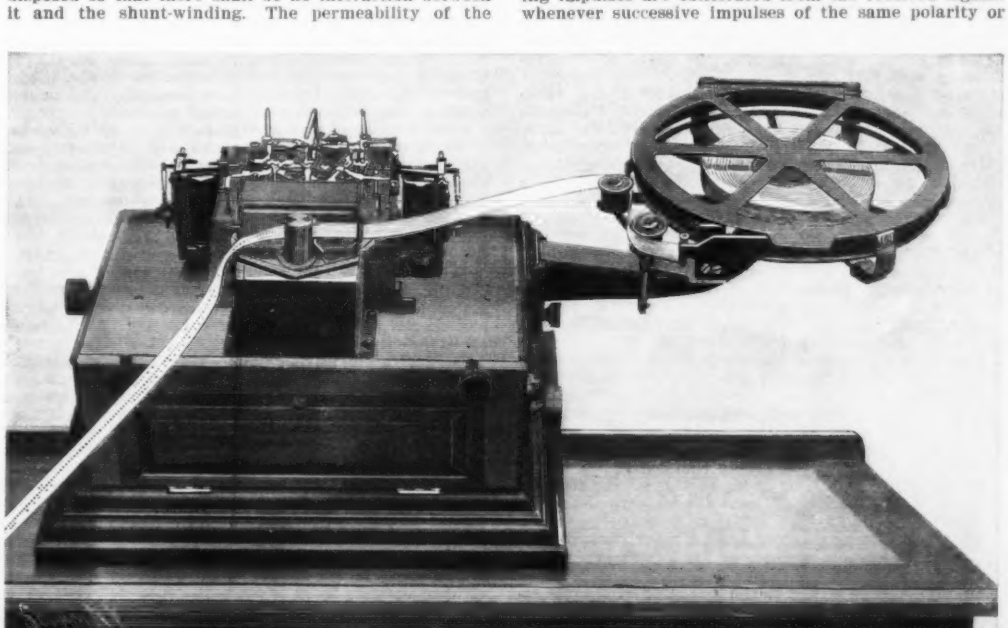


PLATE 3.—AUTOMATIC PERFORATOR.

sign occur. It is therefore evident that if the impulses sent by the relay apparatus into the second cable are to be identical in character with those sent into the first, it is necessary to reproduce the missing "beats." The instrument used for this purpose is called an "interpolator." Its action resembles that of the automatic transmitter at the originating station, with this difference, that the movements of its transmitting levers, instead of being governed by the perforations in the punched tape or strip, are governed by the motions of the relay tongue. The interpolator sends into the second cable impulses similar to those entering the first cable, and these may be either "curbed" or "plain" as required. To use this instrument to the best advantage, it is necessary that it should run in approximate synchronism with the automatic transmitter, and that the speed of the last-named instrument should be nearly uniform.

The interpolator consists of two sets of signaling levers, similar to each other but mechanically distinct. One set sends on the "dot" signals and the other the "dashes." Fig. 2 shows the mechanism of one-half of the interpolator, which acts as an automatic transmitter, forwarding the "dot" signals received by the drum relay from the first into the second cable. The electromagnet, *E*, is worked from the relay, *R'*, of Fig. 1. The other set of mechanism, or "dash" side, not shown, is worked from the relay, *R''*. When the electromagnet, *E*, is energized it pulls down its armature, removing the catch, *C*, from holding the clutch-sleeve, *A*, allowing it to revolve. The clutch-sleeve as it revolves moves the lever, *L*, so as to make contact with the lower contact point, *F*, thus putting battery to line. *S* is a spring-lever worked from a crank-pin on top of the clutch-sleeve; the crank-pin revolving, rocks the lever and operates the reverser, *R*, to which the battery is connected, and this, at stated times in the revolution, reverses the battery, which acts as a curb to the first battery current, or cutting off the battery and putting the line to earth, to act as "plain" automatic as the case may be. By moving the reverser, *R*, relatively to the crank-pin, a bias may be given the spring of the lever *S*. Such a motion will allow of the duration of the curb or earthing period being adjusted. *D* is a spiral spring to help the clutch-sleeve to ride over its lifting rollers. The clutch mechanism is driven by a small governed electromotor. The clutch is more particularly shown in Fig. 3. *S* is a rotating spindle to which the collar, *G*, is fixed. The clutch-sleeve, loose on the spindle, carries at its end the cam plate, *A*, is provided at its lower end with teeth, which are adjusted to gear with similar teeth on the collar. A spring, *B*, tends to force the clutch-sleeve into engagement with the collar. The sleeve is provided with pins or projections, one of which, *C*, engages with the arresting device, and these ride upon fixed lifting rollers, *L L* (which are shown dotted), when the sleeve is at rest, and thereby raise it out of engagement with the rotary spindle. When the arresting device is removed by the magnet, *E*, the clutch-sleeve is pulled off the rollers *L L*, by a spring pulling at the crank-pin, *D*, and thus thrown into gear with the spindle, operating the transmitting levers as previously described.

When an *h* is received from a long cable on the drum of the relay, the tongue remains in contact with the dot side throughout the four beats of the letter, simply producing one long contact on the "dot" post office relay. This long signal is split up by the interpolator and transmitted as four dots.

In place of the interpolator, an "automatic perforator" (see Plate 3) may be employed. The automatic perforator is constructed very much like the interpolator, with this difference, that in place of two there are three clutches adapted to operate punches, by means of cams, for perforating the signals on a paper tape, such as is employed when using the automatic transmitter. To prevent waste of paper, a stopping device is brought into action after the machine has fed out, say five inches of blank strip, this after the last signal has been received. The perforator reproduces on punched tape a fac-simile of the message on the punched tape used at the originating station, and the copy is immediately available for sending on by the usual automatic transmitter. By the use of this auto-perforator it is possible for a single short cable to feed two long ones, or vice versa, with a minimum of delay.

In order that slight failures in the relay apparatus may be instantly seen, it is necessary to have two local registers at the transmitting station, one showing the drum and tongue contacts, the other the signals actually sent into the second cable. The register for showing the drum and tongue contacts of the cable relay has been found to be most valuable and efficient, and automatic translation cannot very well be maintained without it, for it gives a record of what takes place in the most delicate part of the apparatus undisguised by defects of the post office relays, or the defects and corrective effects of the interpolator.

Such a record is seen in slip *A* of Fig. 4. These signals were recorded by a direct writer, worked straight off the drum cable relay. It shows the quality of the contact, and gives an outline of the signals as they arrange themselves on the drum when everything is in correct adjustment. By observing such a record, the relay may be kept in adjustment and faults in transmission easily detected.

Slip *A* is a record of signals received from a cable relay direct at 140 letters per minute over a duplexed cable of 3.2 K. R. under actual traffic conditions. It will be observed that there are no "beats" in the signals when the same follow each other on the same side of the line, the tongue of the relay having held over in these cases without breaking contact.

On the other hand, slip *B* shows signals recorded by a direct writer worked off local circuit with the interpolator; here we have all the signals clearly recorded. Such a record was received from a relay over a cable of 2.8 K. R., simplex working at 210 letters per minute under actual traffic conditions.

In Fig. 5, slips *A* and *B* show records of signals received on the drum cable relay apparatus, worked from a duplexed cable of 2.8 K. R. at 150 letters per minute; the sending battery was 60 volts. The signals were translated by the relay apparatus through an artificial line of 3.5 K. R., the signals being written by a siphon recorder.

Slip *A* shows signals as received on the siphon recorder when an automatic transmitter was used at the originating station; the message was sent on from the relay by a "curb" interpolator. Slip *B* shows signals as received when a couple of sounders were joined up like a hand-key to be worked by the relay in place of the interpolator. Slip *C* shows signals transmitted under similar conditions as slip *B*, but a hand-key was used in place of the automatic transmitter at the originating station.

Having finished the description of the cable relay translation apparatus, I wish now to describe briefly the "magnifying relay," a relay that was the forerunner of the "drum cable relay." I invented the "magnifying relay" in the year 1898. It is not, at present, employed on any of the cables, but I know no reason why it should not be of great use to the cable companies in the future.

As shown in Fig. 6, the instrument consists of a permanent magnet, or direct-current electromagnet, *A*, and an alternating electromagnet, *B*. In the field of the magnet, *A*, is suspended a "recorder" coil, *a*, say of about 500 ohms resistance; in the field of the alternating-current magnet, *B*, is suspended another and similar "recorder" coil, *b*. The suspended coils, *a* and *b*, are coupled together by silk fibers, as is shown in the drawing. The arrival current from the cable, *C*, flows through the coil, *a*, to the earth-plate, *E*, causing the coil to move, and as the suspended coil, *b*, is joined to it by the fibers, *b*, will follow the motion of *a*. *G* is an electric battery. *W* is a current reverser that turns the direct current from *G* into an alternating one. *H* is a condenser of suitable capacity, placed in the circuit so as to neutralize the self-induction and stop sparking at the current reverser, *W*.

If *W* is revolved at a proper speed, the magnetic lines of force will be moving in and out of the iron of the magnet, *B*, say at periodicity of 100 ∽, threading through the suspended coil, *b*, when it is all moved out of its normal or neutral position, and inducing a voltage, proportional to the angle, or more correctly, perhaps, to the sine of the angle of deflection. By these means energy may be generated in the coil, *b*, which may be hundreds of times greater than that employed to move the coil, this greater energy increasing and diminishing in exact proportion to the rise and fall of the controlling current. I should compare this action, if I may be allowed the license, to a driver directing the energies of a horse by a pair of reins. *R* is a rectifier revolving on the same shaft as the current reverser, so as to turn the alternating current induced in the suspended coil, *b*, into a direct or unidirectional current in order that it may operate a "siphon recorder," "direct-writing recorder," or any other suitable instrument, as the case may be, the instrument being placed in circuit with the lead, *S S*.

If the circuit of the coil, *b*, that hangs in the alternating-current field possesses only resistance, the induced current will produce no disturbance on the period of the coils, or on the sensitiveness of the suspension.

To explain this, in Fig. 7 I have drawn theoretical diagrams representing sine wave curves. *I* is the curve of magnetic induction, *A* the curve of induced volts, which is, as is well known, at right angles to the curve of magnetic induction, and *B* is the current curve, which flowing in a circuit of plain resistance would be exactly in phase with the induced volts. This being so, the amperes, as a whole, will produce no reaction on the alternating field, *a I e*, because, as is seen, the portion, *a b c*, is exactly equal to, opposed, and neutralized by, the portion, *c d e*. But it is otherwise, if there is capacity, because then the amperes will be accelerated, this acceleration being due to two E. M. F.'s impressed on the circuit, one due to the moving magnetic lines, and the other to the voltage stored up in the condenser, the portion *a b c* being less than that part of the curve *c d e*, the difference acting on the magnetism so as to cause the coil, *b*, to move out of the field. If there is inductance, the contrary action will take place, in which case the part *a b c* being greater than the part *c d e*, the coil will then endeavor to remain in the field opposing the action to move it out.

Capacity has the same effect as slackening the control of the suspensions, increasing the period of coils and making the instrument more sensitive, while induction stiffens up the coil, reducing the period. This being so, a ready means of adjustment is provided, for by plugging in induction or capacity, the control over the coils may be instantly increased or lowered, and this is so, whatever may have been the initial mechanical control, within reason.

I have arranged the instrument, on some occasions, to work with only one suspended coil, combining the alternating and direct currents on one field-magnet, the current from the cable passing through a choking coil before flowing around the suspended coil. The choking coil stops the induced alternating current from flowing into the cable, while the current from the cable is blocked, say by a condenser, from flowing past the rectifier and wasting its energy in the local circuit. Such a single-coil instrument acts as well as a double-coil one, but I do not know if it possesses any special advantage except on the score of mechanical simplicity.

On trial with the magnifying relay over an artificial cable, I have obtained some rather interesting results. For instance, the slip *A* in Fig. 8 shows signals written by a siphon recorder, worked by a "magnifying relay." The "magnifying relay" acts as a receiver at the end of an artificial line of 7,000 ohms resistance and 310 microfarads capacity. An automatic "curb" transmitter was used as sender, the speed being 150 letters per minute, the sending battery having a potential of only 3 volts. Slip *B* shows the signals received under identical conditions, but with the "magnifying relay" cut out of circuit, the siphon recorder acting as receiver direct. Again, the slip *C* shows signals written by a siphon recorder worked off a "magnifying relay," while slip *D* shows the signals as received by the siphon recorder direct, the relay being cut out of circuit. The currents were transmitted by an automatic "curb" transmitter at 185 letters per minute, with sending battery of 50 volts, the K. R. of the line being 3.6.

Slip *E* shows signals received at a fairly high speed, the siphon recorder being worked off the induced currents of the "magnifying relay," as in slips *A* and *C*, the artificial line had a retardation of 3.6 K. R., the automatic "curb" transmitter was sending with a battery of 42 volts, the speed of signaling was at the rate of 280 letters per minute.

When signals at a moderate speed were being received on the particular magnifying relay used in these experiments, it was difficult to detect by the eye any motion whatever in either of the suspended coils when observed through a strong magnifying glass. Though small in amplitude, it is certain that the motion occurred from the fact that the currents induced thereby were sufficient to cause large and very visible movements in the signaling coil of the siphon recorder.

The "magnifying relay" seems to possess three main points of advantage for cable working:

1. It may be used to work the siphon recorder with the signals of the same size, and at the same speed as at present, but with greatly reduced sending battery power.

2. It may be used to work the siphon recorder with the signals of the same size, the same definition, and the same sending battery as at present, but at a greater speed.

3. I believe it may be used to work over a cable under the same conditions as regards speed and battery power as at present, but the signals may be written by a "direct writing recorder" in place of the present "siphon recorder."

Now I should like to suggest a use for this instrument or part of the instrument for electrical engineers other than telegraph men. Referring again to Fig. 7, and considering only that part marked *B b*: If the winding around the magnet is supplied with an alternating current, say of sine wave form, we have seen that if induction or capacity is introduced in the circuit of *b*, the rectifier being dispensed with, the current flowing in the circuit will be put out of phase with the induced volts, and mechanical reaction takes place between the coil, *b*, and the magnet, *B*, the coil tending to move one way for induction, and in the opposite way for capacity, *b* being supposed suspended in such a manner as to cut some of the moving magnetic lines, its motion being studied by means of a mirror reflecting a spot of light onto a scale.

A complex circuit could be tested and compared with a standard, the deflection showing the resultant capacity or induction; or, perhaps, the capacity, say of such a thing as a coherer, could be found out by this means. I believe that such a reaction galvanometer could be worked up to measure capacity and induction in the same way as an ordinary galvanometer measures resistance.

Messrs. H. A. Taylor and A. L. Dearlove, both of the firm of Messrs. Clarke, Forde & Taylor, pointed out this line of investigation to me. They gave the convenience and necessary encouragement, and have done all in their power to help me in every possible way, and I wish to acknowledge my deep indebtedness to them.

ASEPTIC SURGICAL SHAVING PASTE.*

By Edmund White.

In the St. Thomas's Hospital Gazette, last year, I published an account of a scheme devised for the preparation of skin areas of patients about to undergo surgical operations. It is customary to thoroughly cleanse the skin area by scrubbing with soap, or ether-soap, and in many cases this area is shaved immediately before the operation. Apart from the application of routine methods of disinfection to the hands and appliances of the hospital barber, whose duty it is to carry out this preliminary shaving, the scheme involved the rejection of the ordinary method of shaving by means of lather, since this also involved the use of a brush, which cannot be rendered aseptic. A substitute for the lathering was found in a wax-emulsion, which could be applied by the hand to the area to be shaved, and some particulars of this emulsion and of the details of the scheme will be found in an abstract in the Pharmaceutical Journal of May 3 last. The formula for the wax-emulsion was not, in the original paper, published in detail, because, although the material then in use successfully fulfilled the functions for which it was devised, I thought the emulsion might be improved in several points by further experience in use and manufacture. The formula I now publish is the result of this experience, and it is as follows:

Hard paraffin (m. p. 55 deg. C.)	22 parts by weight
Prepared suet	3 parts by weight
Soft soap	2 parts by weight
Boiling water	68 parts by weight

Place these materials in a vessel surrounded by boiling water, and when the fats are melted beat them together until a smooth, white emulsion is obtained. Continue the beating, maintaining the temperature above 70 deg. C., and shake in gradually

Tragacanth, in powder	2 parts

When the mixture is homogeneous, allow it to cool by removing the boiling water, and when nearly cold add

Glycerin	2 parts
Oil of lavender	1 part

I have employed the ordinary beater mixing machine for making it, but small quantities may be made equally well by means of an egg-whisk in a stone jar standing in a saucepan of boiling water.

My first experiments were made with paraffin, water, and tragacanth alone, but emulsification was troublesome and uncertain, and I afterward found the addition of some other fat, such as suet, lard or tallow, and the use of a little soft-soap greatly facilitated the operation. The tragacanth was then added to impart the necessary viscosity and to prevent the separation of palpable particles of wax during cooling. The ad-

* Read before the British Pharmaceutical Conference, Dundee, August, 1902.

dition of a little glycerin prevents the film drying too rapidly on the skin, but only a small proportion can be used, as larger proportions render the skin sticky.

In use a small quantity is rubbed over the area to be shaved and the razor immediately applied. The amount required varies somewhat with the texture of the skin and hair, but a little practice gives the necessary indication. The material has been in use in St. Thomas's Hospital for about twelve months, and gives satisfactory results. For shaving in the hospital, apart from surgical preparations, its use is compulsory, unless the patient provides his own brush and soap, so that the transference of skin disorders, apart from general septic contamination, is reduced to a minimum.

[Concluded from SUPPLEMENT No. 1393, page 22331.]

THE RELATION OF THE PSYCHIC LIFE TO THE NERVOUS SYSTEM.*

THE beginnings of the psychic life are found in associative memory; education is in the main a training of associations, and the soul develops *pari passu* with the body.

It is found among all vertebrates that when the cerebral hemispheres are completely cut out, associative memory is lost. In sharks there is no associative memory so far as one can determine, and after the cerebral hemispheres are cut out there is extremely little change in the behavior of the animal; it acts in almost a normal manner. In the frog there is so little associative memory that the animal moves in nearly the normal manner after the removal. The frog without a cerebrum is purely a reflex animal, while the normal frog is a little capricious; it does not always respond to the stimulus as a frog without a cerebrum does; so there is a certain amount of nerve impulse—stimulus—in the frog which may serve to inhibit an act, apparently; but still it is in the main a reflex animal, and it has relatively little associative memory, and gets along very well without both cerebral hemispheres; they may be cut away and the frog will live for years and catch flies and be apparently almost a normal frog. In the adder there is no appearance of fear in an animal from which the cerebral hemispheres were removed; otherwise it was nearly normal. In birds complete removal of the cerebral hemispheres causes at first a sleep-like condition lasting for several days, and it was originally believed that the animal never recovered from this—that it remained in a sleeping condition all the remainder of its life, never being able to take food unless forced down its throat; but it is now known that this was a shock effect, due, of course, to the great roughness and coarseness of treatment in cutting away the cerebral hemispheres; and that after the animal has recovered from the shock effect it then behaves in a manner remarkably like that of the normal bird. The animal wanders about untiringly; it sleeps and wakes; it perches at night in order to sleep; its movements are coördinate; it will see; for example, when sitting on one perch, it will estimate the distance and fly successfully onto another perch; so that it has perfect space perception of this sort; it avoids obstacles and all this. These are characters which you might at once suppose, especially the space perception, associated with memory. It is a case of associative memory; the bird must have remembered something about distances in the past; but it is a remarkable thing that when little chickens are first hatched they have this space perception well developed. They didn't learn it; they inherited it; it is a part of their nervous system, their organization, and they are but a moment, they step out of the egg to walk around; they don't learn how to walk; they know how to walk, and it is quite possible that human children do not learn to walk, but hold back because the muscles and the nerves are not ready, and as soon as the muscles and the nerves are ready they walk. As is true of the chick, so the guinea pig walks within a minute after it is born, and walks around perfectly—has no difficulty in coördinating its movements, does not learn these things at all, and has good space perceptions—don't jump off a ledge—will walk to the edge of a high shelf and look over, but does not jump; it has inherited space perception; so that in this case the ability of the bird to fly to its perch does not indicate that it has associative memory and it does indicate that it had inherited—we might call it—past experience, but something which had become a part of its organism, not lodged, however, in the cerebrum, but in the rest of its nervous system.

With regard to what a bird without its cerebrum cannot do, it shows no discrimination of objects; it recognizes neither names of friends nor mate, and takes no interest in its young. Schroeder, who performed the experiment, said that the young might cry for its food, but it paid no attention to its young. All that it had acquired by the activity of memory is lost forever with the loss of the cerebral hemispheres.

It is a very difficult thing to perform such an operation as this on the mammals; yet it has been performed, and successfully. It is one of the triumphs of physiology in this line. Goeltz has succeeded in removing the cerebrum from the dog and keeping the animal alive for years. After the shock effect passed away, in a few days the dog sleeps and walks, moves spontaneously and almost unceasingly while it is awake. That is one of the things wherein it resembles the pigeon, which moves about very rapidly and unceasingly while it is awake. It eats meat and milk when placed to its nose, growls and snaps when pinched, withdraws its feet from cold water, can walk on three feet, closes its eyes when strong light was flashed in them, didn't turn out for obstacles (ran against things); was not able to seek food, and would not eat excepting food was put against its nose; could hear, but did not distinguish between scolding and petting; in short, simple reactions depending on inherited associations were preserved. All these experiments prove that the cerebral hemispheres are the organs for associative memory.

If the brain of the dog be opened and be stimulated certain movements of the leg of the opposite side will occur; that is, if you stimulate the right hemisphere, there will be movements of the left leg; if you stimulate the left hemisphere, there will be movements of the right leg. In the case of the arm you have a little lower area, and in the case of the voice and muscles connected with speech, the tongue and muscles connected with phonation in general, you have a still lower area down here on the side of the brain; and so certain are we of these locations that physicians who deal with nervous troubles are able to predict by the behavior of a patient just where a tumor or a blood-clot is on the brain. I was told by a skilled neurologist of Philadelphia that he had predicted more than one hundred tumors or blood-clots, and they would simply open a space about the size of a half-dollar and find there the tumor. You see how perfect must be such knowledge in order to locate in that way these phenomena; but while these phenomena lead one to believe that the leg, arm, voice and muscles of speech may be controlled from those areas, you must not for a moment suppose that they are controlled only by these areas, because these animals of which I have spoken where the cerebral hemispheres were entirely removed could perform inherited acts very readily. There is a sensory area known as the area of vision; when this is destroyed, or when there are diseases—physiological disturbances—of this area, there appear certain disturbances of vision; and here is an area which when injured will give rise to disturbances of hearing; and of course disturbances of speech would appear in this region here, and of smell in this region which is on the mesial side. There are, then, certain areas which can be located on the cortex of the cerebrum which are concerned with motion (certain organs like the arm, leg, face and the like), and also with sensations; but after we have all these areas plotted and located there remains about two-thirds of the human cortex still unassigned.

There is a great deal of conflicting testimony with regard to many of these areas and centers, in spite of the definiteness that I have spoken of in predicting certain possibilities. Not all such lesions cause disturbances; a great many persons have had tumors on the brain and did not show evidences of it; and not every lesion of the brain will produce these sensory disturbances. A man had a crowbar shot through his head which tore out the main portion of the frontal lobe; yet the man afterward was a reasonable, intelligent man—possibly not quite so intelligent; they say it changed his disposition a little bit; but otherwise he was quite a reasonable sort of man and lived a good many years. Dr. Loeb says he has cut off the frontal lobe (supposed to be the seat of the soul) in many dogs; he knows no operation in dogs that is more harmless; the dog is really injured less than by almost any other operation. All these things tend to create more or less disturbance—and do—with regard to cerebral localization; but while we may readily assume that there is a localization, that is, an anatomical localization of fibers—there is no doubt about it—yet the whole trouble is that there is such an opportunity for the spread of impulses from one cell to another, like a sort of flashing over the hemisphere, that it is difficult to isolate any one spot and say, "This must be the center of such and such an act."

The dog will very quickly recover from an operation of cutting out certain of these centers. Loeb has cut out all these association centers which Flechsig has described, and the dog remained quite intelligent. Monk holds the removal of the visual sphere (the area of vision) produces psychic blindness, that is, they see, but do not recognize what they see. Loeb says that is a form of color blindness, just as if you had cut a part of the optic nerve. Monk found that dogs, after six weeks, would learn again the objects which they had lost. As he thought, the images were in their brains, that is, if we cut out a certain area of vision, the dogs would not recognize the things they saw, but in about six weeks they would begin again to recognize things, and he thought in the meantime they had trained other cells by their intervening experience; so he took a dog and cut out the visual area; put him in an absolutely dark room for six weeks; then he brought the dog out, and after the shock was over he at once recognized, showing that his vision was all right and that something was wrong in the former conclusion.

If the word "rose" is pronounced, I not only get the sound of the word; it goes to the auditory center, but it also arouses a visual image, and it arouses an odor—an image of certain odors to me, as well as an image of taste and so on; we may have a large number of centers stimulated from a single center. How is it possible to assume that you have a single center for memory when, so far as known, vision is in large part located in this region, hearing in this region, and smell and taste down in this region on the mesial side of the brain? In short, it seems impossible to localize in a hemisphere these phenomena; they are rather phenomena which concern the whole of the hemispheres. That that is true is shown in various ways. You may take out one hemisphere of the brain from a dog, and it still remains an intelligent dog; it perceives objects and remembers and behaves like a normal dog, although it has lost one-half of its brain; but if you cut off one-half of the brain in the other way, that is, if instead of taking this half of the brain you cut the brain in two this way and take half of it, then the dog becomes hopelessly idiotic; he has lost a great many associations that he had, and he is thereafter an idiotic dog. You may cut off the anterior or posterior portion and it does the same thing. The removal of the dog's frontal lobe, destroying the tracts of vision, sensation and emotion, will cause the dog to go about with his head down and be surly; whereas, cutting off portions of the occipital lobes improves the nature of a dog; he is always happier and better-natured.

Protoplasmic sensibility is the germ out of which the sense life grows, as the egg is the germ out of which the adult body grows. We face here the problem of generation, namely, the extent of preformation or new formation, which varies in different cases; but it is certain that elements are present in the egg which under suitable conditions develop into adult structures, and that elements are absent in dead protoplasmic material. Both structurally and functionally the germ is relatively simple, and from its simple qualities come the complexities of the adult. Consciousness is not present in the egg, nor are vertebræ nor any other adult characteristics. The qualities of water are not present in either hydrogen or oxygen, nor those of ammonia in either nitrogen or hydrogen; by the combination of these elements new qualities arise; and the same is true of the development both of the body and the soul. It is a timeworn argument that you cannot have in the whole what does not exist in any of the parts; but the falsity of this statement is seen at once when applied to chemical compounds in general; for you do have in the water what you do not have either in hydrogen or oxygen.

You are asking, "What is the ultimate relation between the psychic life and the nervous system—between mind and matter? Let us hear your conclusion of the whole matter." I almost fear to tell you that upon the ultimate relations of mind and matter I have no conclusions to which I am absolutely committed. I know not why it is; but in this world of uncertainty and doubt almost the first requirement in an investigator is that he shall commit himself to some hypothesis or other. To regard all hypotheses in an equally impartial way—most of all, not to form a new hypothesis of his own, for which he is willing, if necessary, to stake all—is generally considered to be an element of weakness; but in this case I frankly confess to that condition of indecision.

The relation of mind to body is best represented by the connection of function and structure. There can be no sensibility without protoplasm; no normal protoplasm without sensibility; no intellect without brain; no normal brain without intellect; I do not know how protoplasmic structure conditions sensibility, nor how brain structure conditions mind; yet to me it seems probable that they do condition each the other. Sensibility is not the cause of organization, nor is organization the cause of sensibility, but they are different aspects of the same thing—life. Dubois-Reymond said that the first appearance of life would offer only a mechanical problem were it not for the fact that the germs of psychic processes which we are not able to record are found in the most primitive and simplest organisms. Others believe that even these psychic processes are explicable in terms of chemistry and physics; but when I consider that according to this view, chemical and physical processes in nerve cells must produce that which is neither chemical nor physical, namely, sensation, consciousness and will; when I reflect that if consciousness is the result of molecular movement, a particular mode of development must enable molecules to recognize themselves as distinct from others; and, most of all, when I consider that molecules and atoms are themselves but the creatures of the mind—I realize the absurdity of trying to explain the soul—the creator of such symbols—by the symbols created. Although philosophers and scientists may well perhaps speak of it that things are not what they seem, and that the will cannot be wholly free, yet the universal recognition both by individuals and society of personal responsibility is a phenomenon which, so far as I know, has not been—cannot be—explained on mechanical grounds, and which we dare not assert to be a child of evolution. As Prof. Harper says, it is clearly impossible for those who teach that consciousness is a by-product and never a cause of physical energy to dispute that actions arise; and just as every individual of the human race would have been exactly what they have been in the absence of mind—if mind, of course, has no influence on these things—had mind been wanting the same empires would have risen and fallen, the same battles would have been fought and won, the same literature, the same masterpieces of painting and music would have been produced, the same religious rites would have been performed, and the same actions of friendship and affection given—to this absurdity realistic materialism stands committed; with these things in mind we cannot but agree with Prof. Huxley when he calls materialism a shallow philosophy. On the other hand, assuming the position which I have taken that the mind is related to the body as structure is to function—as function is to structure—we do not know how function is related to structure, how mind is related to matter; we do not know, and it is useless for us to dogmatize about it. In the presence of this mystery of mysteries we can only say—*ignoramus*.

* Abstract of a lecture delivered before the Society of Ethical Culture, Philadelphia, by Prof. E. G. Conklin, Biological Department, University of Pennsylvania.

SOFT COAL AS AN EMERGENCY FUEL.

THE question so often asked, What will the people of New York do if the anthracite strike lasts until cold weather? may be answered without difficulty. They will burn soft coal.

The furnaces and ranges designed for anthracite will burn any grade of bituminous coal which reaches this market. If intended for that fuel they would have been made somewhat different as to their draught openings, firepot linings, and smoke exits, but the difference is not so great that as an emergency fuel for two or three months, or longer if necessary, the New York householder cannot do very well with soft coal as a domestic fuel in both cooking and heating. There are reasons, perhaps, why the coal dealers have not made this fact more generally known; but fact it is, and the prudent householder may find specific information on this point useful.

Soft coal in a range or cook stove will meet all the requirements of domestic use if ordinary intelligence is displayed in the management of the fire. The same is true of hot-air furnaces. With the low-pressure boilers used for steam heating somewhat more trouble may be expected, but this is largely a question of the type. Even in such devices soft coal can be burned without an amount of inconvenience comparable to that of an uncomfortably low house temperature. Probably the greatest difficulty will be that experienced in changing the habits of servants who have never known any fuel except anthracite. Filling the firepot of a range to the lids with soft coal will not give good results, and attempts to broil over fresh fuel will be disappointing, though for this purpose a bed of glowing coke is vastly better than one of incandescent anthracite. Care must also be taken in keeping oven temperatures uniform. Soft coal ignites very quickly, dies down with equal facility, and needs constant watching and frequent

replenishing to maintain even a measurably constant fire. In these respects it more resembles wood than anthracite, but it burns very nearly as well in an anthracite range as in one built for a market where only soft coal is used as a domestic fuel.

In an anthracite-heating furnace soft coal needs to be treated very differently from anthracite, but the difference consists in the management of draughts and checks. In the feed door of every furnace there is a slide damper to admit air over the fire. When anthracite is used this is opened only if it is desired to deaden the fire and lower the temperature of the house. With soft coal it must be left open all the time. The great volume of gases evolved from it in the coking process, which is the first stage in its combustion, calls for more air than can be had through the body of fuel, and unless this is supplied above the fire the greatest value of the fuel is lost up the chimney in unconsumed gases. Too much air for good combustion can be admitted over the fire, but this is not likely to be the case if the slide damper in the feed door of a furnace built for anthracite is left wide open all the time. The draught opening in the ashpit door, on the other hand, needs to be less widely and continuously open than for anthracite. With the same amount of bottom draught which it is customary to give hard coal, soft coal would simulate the combustion in a blast furnace and call for constant stoking. The householder must also remember that the check draught in the smoke pipe, which with anthracite is usually kept open in moderate weather, cannot be opened much, if any, with soft coal, or the house will fill with smoke. The best way is to leave it closed altogether. With attention to these details, which reverse the customary practice with anthracite, a furnace may be run on bituminous coal so as to keep a house entirely comfortable.

It will be found difficult, if not impossible, to keep either a range or furnace fire overnight with soft coal unless one has a watchman on duty to look after it. As an offset to this, however, we have the ease with which a fresh fire of soft coal may be lighted and its almost instantaneous response in heat-imparting efficiency. It kindles nearly as easily as shavings, and the coke of the previous fire does not have to be removed from the firepot. All that is necessary is to shake down the fine ash and make the new fire upon what remains. With a little judgment, one having a small supply of anthracite available, may run his furnace through the day and evening with soft coal, and by adding anthracite at night have a fire in the morning. But with no anthracite at all he can, with a little more trouble than he is accustomed to, keep his house comfortable with soft coal.

Within the next thirty days these facts may be of great practical interest to the householder. Most of the rumors of strike settlement now in circulation have their origin in schemes of political advantage, and whatever the result anthracite is likely to be costly and hard to get except in a small way for some months to come. Public opinion will not sustain the Board of Health in imposing impracticable conditions upon those whose consumption of soft coal is attended with only so much smoke as is incidental to its use as an emergency fuel; and with such intelligence in the management of fires as should be gained from a single day's experience, the amount of smoke a household would make from range and furnace will not constitute a public nuisance. It is very certain our people need not go hungry or cold, and equally certain they will not.—The New York Times.

BRAIN AND INTELLECT.

THE exact seat in the brain of the highest intellectual faculties has formed a moot point in science since the functions of the organ of mind began to be investigated with accuracy. The general consensus of opinion localizes what we term "mind" in the prefrontal lobes of the brain, but by another school of thinkers the hinder lobes have been credited with performing our highest cerebral duties. The balance of evidence, I should say, is decidedly in favor of the former view, and recent researches and observations by Dr. Phelps, an American investigator, would appear to assist in strengthening the opinion that the most important portion of the brain is its anterior region. In the course of the investigations in question some 295 cases of brain injury and disease were examined. In all save two it was noted that interference of extensive nature with the prefrontal region resulted in serious disturbance of the mental faculties. Less severe injury produced less marked effects. These facts parallel the researches of other investigators, and they are further substantiated by what is observed in cases of idiocy connected with a want of development of the frontal lobes of the brain.

As to the relative importance of the two lobes or halves of the cerebrum, or chief brain mass, most of us know that each half governs the opposite side of the body, and that, as we are right-handed, so we may be called left-brained. The superiority in functional importance of our left brain is not questioned, and it is therefore interesting to find Dr. Phelps insisting, from the results of his investigations, that our left brain lobe is really the intellectual half. The right half, it is added, is capable of sustaining severe injury without marked mental effects supervening, and cases are quoted in support of this fact. Indeed, such cases have frequently puzzled physiologists, seeing that the disturbance of the intellect has in no sense been commensurate with the injury to the brain. On the notion of the greater importance of our left brain, and on the theory that severe injuries which do not produce utter mental breakdown really involve the right lobe, the puzzling constitution of the brain may be explained in part at least. But the last word has not yet been said concerning the brain's ways and work. Injuries of the left half do not always produce serious effects as regards the mental life, while we have had some physiologists insisting that we have really two brains, and that while the left lobe is the Jekyll of the intellect the right, on occasion at least, is apt to play the part of Hyde. A fascinating theory this, but one to which sober science is not likely to append its imprimatur.

A REVIEW OF THE EXISTING METHODS FOR CULTIVATING ANÆROBIC BACTERIA.*

By OTTO F. HUNZIKER.

SINCE the discovery by Pasteur in 1861 of the fact that some species of bacteria can thrive in the absence of oxygen only, various methods have been introduced involving many devices for the study of anærobic bacteria. Notwithstanding this fact, our knowledge of anærobes is as yet very limited. While bacteriology has made rapid progress along the line of ærobic species, a comparatively small number of anærobic species have been carefully studied and identified.

Concerning the character of some of the known anærobes, such as the bacilli of tetanus, of malignant œdema, and of black leg, it becomes evident that the

FIG. 1.

cause of the slow development in the study of anærobic species does not lie in the fact that these species are of less pathologic and economic importance than their brothers the ærobes. Nor can it be attributed to the assumption that this class of organisms covers a very limited number of species only, for the results of bacteriological research of recent years are rapidly revealing the existence of a liberal distribution of anærobic bacteria in nature.

On the other hand, the bacteriologist realizes that the production of anærobic conditions for bacterial growth involves greater difficulties and meets more frequently with failure than the simple cultivation of ærobes. It is, therefore, reasonable to recognize this greater difficulty, complexity and expense of technique as the most potent obstacle in anærobic research.

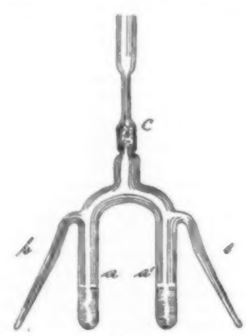


FIG. 2.

While, from the above statement, it is obvious that none of the methods for anærobic cultures are quite so simple and easy as those of ærobes, still a thorough review of the multitude of methods introduced and devices invented shows that there are some that involve little difficulty, are simple, and can be manipulated in any laboratory. Methods for the cultivation of anærobic bacteria are referred to in most text-books and manuals on bacteriology; however, space in such books does not permit a full list of these methods, with directions for practical application; and a search through the entire bacteriological literature in pursuit of the easiest, simplest and most efficient method is a task that does not appeal to the investigator eager to grow cultures with the greatest economy of time. In order to fill this gap, to afford the investigator easy access to the existing methods, and by so doing encouraging the study of anærobic bacteria, it was


FIG. 3.

thought desirable to carefully review the literature on this subject, and to present the principal methods and their modifications in this article.

For the purpose of being able to treat the diverse methods in logical order, the principles upon which they are based are arranged in the following classification, in which order they will be reviewed.

The anærobic conditions are brought about:

1. By formation of a vacuum.
2. By replacement of air by inert gases.
3. By absorption of oxygen.
4. By reduction of oxygen.
5. By exclusion of atmospheric oxygen by means of various physical principles and mechanical devices.
6. By the combined application of any two or more of the above principles.

METHODS FOR CULTIVATING ANAEROBIC BACTERIA IN A VACUUM.

In the search for methods that would enable the investigator to obtain cultures in the absence of oxygen, the principle of exhaustion was naturally one of the first resorted to. It was much used in early research concerning anærobic bacteria. While absolute anærobic conditions can be obtained in a vacuum only, the difficulty of successful evacuation and the fact that a good vacuum pump generally lies beyond the means of small laboratories, explain the reason why the principle of exhaustion has been losing ground in recent years and is gradually being replaced by more simple and less expensive means to produce anærobic conditions.

Pasteur's Method.—Use a small flask with a long neck or test tube; fill it one-half (in case of flask) or one-third (in case of test tube) with the inoculated medium. Constrict the neck at *b* (Fig. 1) and connect the end of the neck *c* with the vacuum pump. While evacuating place the bulb of the flask or the tube in a water bath at 37 deg. C., causing the liquid to

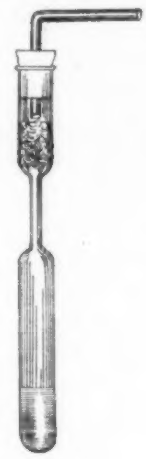


FIG. 4.

boil. Evacuate for thirty minutes; then, while still exhausting, seal at *b* in the flame.

According to Fitz this is the oldest and simplest method; it was introduced by Pasteur and tested by Cohn, Lister, Tyndall, Aitken and Fitz. Nenki introduced a method identical with the above.

Roux, in 1887, modified Pasteur's apparatus as shown in Fig. 2. This type of apparatus has been in constant use in Pasteur's laboratory for many years. The bulbs, *a* and *a'*, hold the medium, which is introduced through the lateral capillary tubes, *b* and *b'*, by means of suction at *c*.

Method.—Push a loose cotton plug into tube, *c*. Seal the lateral tubes, *b* and *b'*, in the flame and sterilize the apparatus in the hot air sterilizer. Break off the tips on the lateral tubes, *b* and *b'*, and immerse the tubes in bouillon. Apply suction at *c*. When the tubes, *a* and *a'*, are about one-third full seal the ends of the lateral tubes again and sterilize in steam sterilizer. When cool reopen the lateral tubes and introduce the inoculating material by suction at *c*. Melt off the lateral tubes in the flame and connect *c* with a vacuum pump. When completely evacuated seal tube, *c*, at its constriction and remove the apparatus to the incubator.

In this apparatus two cultures may be grown simultaneously. Apparatus shown in Fig. 3 works on the

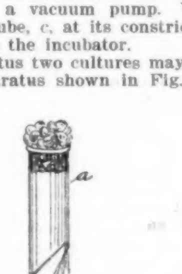


FIG. 5.

same principle with the exception that it can take care of only one culture at a time. The latter can also be used for cultures on solid media and Esmarch roll cultures.

Gruber's Method.—Take a long test tube 22 to 25 centimeters long. About 15 centimeters from the bottom draw it out into a constriction as illustrated in Fig. 4, plug the tube with cotton as usual, and sterilize. By means of a funnel pour about 10 cubic centimeters of the sterile medium and 2 cubic centimeters of sterile water into the tube and sterilize. Then inoculate the medium as usual. Push the cotton plug well down into the tube and insert the rubber stopper. Connect the glass tube in the rubber stopper with a vacuum pump and immerse the lower part of the test tube in water at 37 deg. C. in case of bouillon or gelatin, and at 42 deg. C. in case of agar. In ten to fifteen minutes the tube is evacuated. To avoid wetting of the cotton plug by the boiling and foaming medium, the constriction may be slightly and carefully flamed. While still evacuating, the tube is sealed in the flame. If agar is used, cool the hermetically sealed tube in a water bath to 40 deg. C., then roll it until the medium congeals; in case of gelatin cool slowly in the

*Journal of Applied Microscopy and Laboratory Methods.

air by constant rolling of the tube in the hand, so that at room temperature the vacuum is filled with vapor. In case of bouillon cultures the operation is finished as soon as the tube is sealed.

Roux's tube for potato cultures in vacuum is operated in the same way, but the potato is introduced into the test tube and the inoculation is made before the tube is constricted. The same investigator also recommended for potato cultures a tube as shown in Fig. 5. As soon as the potato in the culture is inoculated the tube is sealed at *a*, and the lateral tube closed with a cotton plug is connected with the vacuum pump. When evacuated the lateral tube is sealed in the flame at *c*.

Novy constructed an apparatus for plate cultures in vacuum (Fig. 6). It consists of a cylinder ending in a

FIG. 6.

firm, broad rim. On the rim is placed a thick rubber ring. The cylinder is closed by a bell jar, the lower rim of which corresponds with the upper rim of the cylinder. The whole apparatus terminates in a stop-cock.

Method.—Place the inoculated Petri dishes in the cylinder, invert the bell jar over it, and close firmly by applying clamps with rubber lined jaws to the union of the cylinder and bell jar. One end of the turn cock (*x-y*) is connected with a thick-walled rubber tubing which is closed by a screw compressor. The other end is connected with a vacuum pump and when evacuation is complete the turn cock is turned and the vacuum pump is disconnected.

Zupinski, in 1898, introduced a new and simple method of evacuation. It is based on the principle of Torricelli's vacuum. The apparatus (Fig. 7) consists of a tube which is constricted at each end, each con-

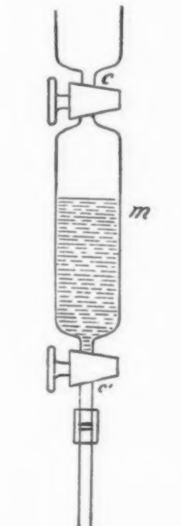


FIG. 7.

striction carrying a glass turn cock, a long glass tube holding a column of mercury, and a small beaker filled with mercury.

Method.—Fill tube, *m*, completely with medium; inoculate through *c*, connect the constriction at *c'* by means of a piece of stout, elastic rubber tubing with glass rod, *g*. Close both turn cocks. Reverse the whole apparatus, fill the glass tube, *g*, with mercury; close the end with the finger and return the apparatus to its original position, Fig. 7, standing the open end of the glass tube, *g*, in a beaker, *b*, containing mercury. The column of mercury falls to 750 millimeters, and above it there is an absolute vacuum, the Torricellian vacuum. Now open cock, *c'*, instantly the medium descends and above it there is formed an absolute vacuum. Close cock, *c'*, and paraffin it. Remove glass tube, *g*, and put the apparatus into the incubator. The diameter and length of glass tube, *g*, govern the capacity of the vacuum. The gases produced by bacterial activity can evolve without endangering the apparatus and can be examined without interference by other gases.

For the above method any flask or test tube may be used. When filled with inoculated medium it is closed with an air tight, mono-perforated rubber stopper. The perforation carries a snugly fitting glass tube which is connected with a long, heavy glass tube by means of a short piece of rubber tubing, carrying a firm clamp, which serves in the place of the glass turn cock. The manipulation is the same as with the previous apparatus.

While the few devices and methods described in this category appear to be the only ones specially designed for vacuum cultures, there exist a large number of apparatus which may be and have been used for this purpose. Thus most of the devices invented for anærobic cultures in an atmosphere of inert gases may easily be adapted for vacuum cultures. For their description the reader is referred to their respective classes.

(To be continued.)

MR. PARSONS' JOURNEY ACROSS HU-NAN.

EXTENDING south of the middle portion of the Yang-tse-kiang River and populated by some 20,000,000 people, lies the Hu-nan province, famous for its vast coal fields, for its trade, and, above all, for its stern exclusiveness. Few foreigners have ever entered the province. The little that is known of its commerce and geography has been gathered from the lips of natives. Indeed, so far has this policy of exclusiveness been carried out, that not only has the "foreign devil" been shut out, but the Chinese of other provinces as well; and that is why Hu-nan is called the "closed province." William Barclay Parsons, to whom New York's subway is due, is one of the few men and perhaps the only white man who has ever journed across the province. About three years ago he was commissioned to make a survey for a proposed railway from Hankau to Canton. All doors were opened to him; for the Imperial Government had provided him with peremptory passports.

Hu-nan is about four times as large as the State of New York, and except for a wide plain at the north it is mountainous, valley bottoms being, as a rule, small and narrow. One of the most interesting cities in China is Chang-sha, the capital of this province and the most anti-foreign of all Chinese cities. Only two or three foreigners had ever succeeded in getting within its walls, and they did so either surreptitiously or at night. After long negotiations Mr. Parsons persuaded the Governor to receive his whole party at a formal audience with full Chinese etiquette, the first foreigners to be so treated. Mr. Parsons estimates the population at 500,000, though the Chinese claim 1,000,000.

The streets are of the usual Chinese type, narrow, but well paved, and the houses for the most part are well built. The shops seemed to be generously supplied with all kinds of goods, both native and foreign. In view of the attitude of the people toward foreigners, it was interesting to observe how well the shops were furnished with foreign commodities. There were not only the regular line of staple goods, such as cottons, kerosene oil, lamps, umbrellas, timepieces, etc., but articles that one would scarcely expect to find in a city where no foreigners resided, such as American tinned vegetables and fruits, and English and German beer. As a further indication of the demand for foreign articles may be noted the establishment of a branch of a well-known firm of English chemists of Hong Kong and Shanghai. This branch is in charge of a Chinese attendant, who, while he cannot compound foreign medicines, nevertheless sells all the ordinary preparations. Mr. Parsons was able to replenish part of his stock of medicines and foreign goods in this most anti-foreign city.

Chang-sha is also a flourishing manufacturing center of wooden articles, principally furniture and coffins, in silver and pewter ware and paper. When the present Emperor was first in power he appointed as Governor of Hu-nan a liberal and advanced official named Chen Pao-cheng, who endeavored to overcome the antipathy of the Hu-nanese to foreigners. He founded what are called "foreign" schools, namely, those where science and modern subjects are taught, inviting Chinese teachers to come from Shanghai for this purpose, and even went so far as to install an electric light plant and a telegraph line.

With the advent of the Empress Dowager to power, Chen Pao-cheng was dismissed and Yu Lien-san, a conservative, was put in power, who immediately set about to undo what his predecessor had begun in the way of reform. As a singular indication of the value of modern science as an agent of reformation, the electric light, having demonstrated its practicability and its advantages, was not only allowed to remain, but was actually extended. Chang-sha therefore presented the curious anomaly of being most hostile to all foreign ideas and yet using one of the few foreign inventions which does not claim previous Chinese origin.

Hu-nan invites wide attention for its coal measures. As no systematic investigation of the province has ever been made it is still impossible to give complete details. The only notes hitherto obtainable on the geology of the province are those collected by Richthofen, whose observations, however, were made wholly from boats. The rocks of the northern part of the province are soft sandstone. The coal measures begin at some point near Siang-tan, a large city on the Siang River, about thirty miles south of Chang-sha; they extend easterly to the boundary between Hu-nan and Kiang-si and westerly for an unknown distance. The greater part of Hu-nan coal is anthracite, and as the natives prefer to burn what they call non-smoky coal in their chimneyless houses no large effort has been made until recently to explore the bituminous deposits. The brief account that Mr. Parsons gives of what he learned of the various coal fields gives an idea of the wonderful extent of the Chinese coal beds and of their future importance in commerce and industry.

The great coal field of Hu-nan, which has made the province famous, is the Lei-ho field, which extends southerly from the junction of the Lei and Siang rivers and covers the Lei Valley. This coal being easily mined and having water transportation facilities at hand, has been worked for a great many years, and has found its way to all points, not only in the Siang Valley, but along the Yangtse as far as Shanghai. As it has been chiefly anthracite, the term Hu-nan coal has become synonymous with that variety, and it is likely that coals that have come from other parts have been and are sold under the trade name of "Hu-nan coal."

The Hu-nan coal field is very extensive and contains an enormous tonnage of coal of different varieties. It needs careful, thorough and systematic exploration with a diamond drill, for it is probable that the most valuable deposits will be found below the surface, where they may be more compact.

On account of the mountainous topography, Hu-nan does not rank high as an agricultural province except in the northeast. Tea and rice are the most important crops. Besides coal there are iron, copper, antimony, lead and silver that have not been developed, though they are believed to exist in paying quantities. Mr. Parsons believes that on account of its mineral wealth and its location on the natural highway between central and southern China, Hu-nan is certain to be a great factor in the future commercial and industrial growth of the empire.

THE FIRST FRUITS OF THE GERMAN ANTARCTIC EXPEDITION.*

THE protracted voyage of the "Gauss" from the Elbe to Cape Town excited some anxiety at the time, and called forth a few comments unfavorable to the sailing power of the ship. It appears, however, that the delay was due mainly to the fact that many days were spent in carrying on oceanographical and magnetic work, although the change of programme which led to the abandonment of a visit to Ascension shows that the duration of the passage did to some extent exceed anticipations. The "Gauss," we may recall, left the Elbe on August 15, 1901, passed the Lizard on the 20th, called at St. Vincent in the Cape Verde Islands on September 11, and reached Cape Town on November 23. The work done in various branches of science was discussed in a preliminary manner on board, and an account of it was issued in March in a paper of 108 pages, with numerous maps and diagrams, by the new Oceanographical Institute in Berlin and the Geographical Institute of the University of Berlin, under the direction of the head of both institutions, Baron F. von Richthofen.† The work, though mainly in value in the instruction it afforded the workers, still constitutes a contribution to our knowledge of the Atlantic, and promises well for the scientific harvest which we hope the "Gauss" has by this time begun to reap in less known waters.

The memoir consists of four parts—a general report of the expedition by the leader, Prof. E. von Drygalski, seven reports on the scientific work of the various specialists on board, technical reports by the chief engineer and the captain of the ship, and finally a special report on the establishment of the auxiliary station at Kerguelen.

As the investigators on the "Discovery" brought themselves into working order by monographing the island of South Trinidad, those on the "Gauss" set about the general description of St. Vincent in the Cape Verde group as their first exercise. Dr. Emil Werth describes the topography and types of vegetation of the island, and Dr. Philippi gives a brief account of the geology. The island is described as an ancient volcano, the central plain corresponding to the crater, the rim of which survives in parts as a peripheral mountain-chain.

The more systematic work of the expedition commences with Prof. von Drygalski's report on the oceanographical observations which were his special care. As far as the equator these were confined to the surface, but from the equator southward deep-sea observations were added at regular intervals, along the course which lay alternately a little to the west and a little to the east of the meridian of 20 deg. E. The superficial conditions are very ingeniously shown by means of curves drawn on the map of the route, the abscissæ being the projection of the track on the meridian and the ordinates the values of temperature, salinity and density *in situ*. The surface temperature closely following that of the air, rose steadily from 17 deg. C. at the mouth of the English Channel to an average of 27 deg. in the Doldrums (16 deg. N. to 5 deg. N.), then fell to 24 deg. at the equator and remained steady to 15 deg. S., after which it fell steadily, reaching 18 deg. C. in 30 deg. S. The salinity curve showed maxima in the tropics both north and south, separated by a minimum in the belt of calms at 7 deg. N. The density of surface-water *in situ* remained constant between the temperate zone and the tropics in both hemispheres, but fell to a single minimum in the equatorial belt of calms, where the maximum temperature met the minimum salinity. Samples for the determination of density and chlorine were collected every four hours and a number of different methods were employed for making the determinations. Titrations of chlorine were controlled by Knudsen's standard samples of sea-water, which were supplied to the expedition for the purpose. In addition to two patterns of direct-reading hydrometers, a set of Nansen's total-immersion hydrometers by the use of which the troublesome factor of surface-tension is eliminated were utilized, and a refractometer was also employed for the optical determination of the density of the sea-water. The value of the salinity deduced by Knudsen's tables from the chlorine determinations was always found a little lower than when deduced from hydrometer or refractometer observations; the mean error of the determinations was found to be least for titration of chlorine and greatest for the refractometer. The chief difficulty with regard to that instrument was found to be the temperature correction;

* Nature.

† Bericht über die wissenschaftlichen Arbeiten auf der Fahrt von Kiel bis Kapstadt und die Errichtung der Kerguelen Station.

but Prof. von Drygalski points out the very decided advantage of the immersion refractometer with which the "Gauss" is provided over the differential refractometer formerly used.

The color of the sea-water was systematically observed, but the range of Forel's xanthometer being found insufficient, the more extensive scale of colors used by Luksch on the "Pola" expedition was adopted instead.

Deep-sea soundings were made with a modified Sigsbee machine. Using a detaching weight of 35 kilogrammes as a sinker, soundings were completed in 5,000 meters (2,770 fathoms) in seventy minutes in calm weather. Prof. von Drygalski found the Negretti and Zambra reversing thermometer unsatisfactory for deep soundings, on account of the shaking of mercury out of the inverted bulb in hauling up through the hot tropical surface-water. The Miller-Casella thermometers, on the other hand, acted admirably, and he regretted not having taken a larger supply. We think, however, that in the very different conditions of the polar seas this opinion of the relative utility of the two types of instrument will very likely be reversed.

On the voyage between 37 deg. N. and 34 deg. S. no fewer than thirty successful deep-sea soundings were taken, of which nine gave depths exceeding 5,000 meters (2,770 fathoms), and the deepest as much as 7,230 meters (3,950 fathoms). The positions of the soundings were chosen so as to throw light on special problems of sub-oceanic configuration.

Opportunity was taken to test the Pettersson-Nansen insulating water-bottle in these depths, and the result was to show that the great contrast of temperature between the bottom and surface in the tropical seas was too much for the power of insulation, and that the inner cylinder of water altered its temperature somewhat before a reading could be made. This difficulty will, of course, not be experienced in the more uniform temperatures of polar seas.

An interesting fact brought out by the determination of salinity as well as temperature at each point of observation was that about the depth of 800 meters, where the sudden change in the temperature curve occurs between the warm upper and the cold lower waters, there occurs an actual inversion of the salinity curve, showing that a stratum of minimum salinity is interposed between the two salter layers.

The study of oceanic deposits brought out some new facts, and suggests problems not very easy of solution. By using sounding tubes of 2 or 3 centimeters diameter and 200 centimeters long some very long cores were obtained. One of these, from the depth of 7,230 meters (3,950 fathoms), in 0 deg. 11 min. S., 18 deg. 15 min. W., showed distinct stratification. The core was 46 centimeters long; the uppermost 13 centimeters consisted of red clay containing numerous fragments of volcanic rock, then followed in order four bands of different color, passing from brownish-gray to dark and then light gray. The dark gray layer distinctly resembled a terrigenous deposit, and the light gray layer, the lowest of all, was the only one containing a perceptible proportion of calcium carbonate. The bearing of this observation on past changes in the configuration of the ocean and the distribution of land is pointed out. A still more curious specimen was a core 69 centimeters (say 2 feet) long, obtained in 35 deg. 52 min. S., 13 deg. 8 min. E. from a depth of 4,957 meters (2,750 fathoms). The uppermost 11 centimeters consisted of a brown clayey quartz sand, with very little volcanic or calcareous material, while the next 12 centimeters were almost pure globigerina ooze with fragments of the upper layer, and the greater mass of the section consisted of material similar to the upper layer, but with the clayey material predominating over the sand. Dr. Philippi could not account for this appearance of sand in a pelagic deposit by considerations of the prevailing wind (which blows toward, not from, the South African deserts), or by currents, so he is driven to suggest that the material is ice-borne, though he acknowledges the difficulty of icebergs in sufficient numbers reaching so low a latitude.

The biological work was very fully developed on the voyage, and in addition to a close watch being kept on the changes in the surface plankton by continuous tow-netting, attention was devoted to the use of very large wide-meshed nets (one was of 7 meters diameter) for horizontal towing, and to a vertical net of 2 meters diameter. A somewhat unexpected result of the latter was the discovery that very young fishes increased in number with the depth. Thus in a vertical draught from 500 meters twelve "fischchen" were found, in one from 800 meters fifteen, from 1,000 meters thirty-two, from 1,200 meters thirty-six, from 2,000 meters forty-three and from 3,000 meters no fewer than ninety-six. Most of them belonged to the genus Cyclothone.

Dr. Bidlingmaier enters very fully into the methods and difficulties of magnetic work at sea. The two principal instruments in use are a Bamberg's deviation magnetometer and a Lloyd-Creak inclination instrument identical with that supplied by the "Discovery." The results are not yet ready for publication, but a number of observations were made both at the ports of call and at sea. At Cape Town Profs. Beattie and Morrison repeated the comparison of their own instrument with those of the expedition which they had made a short time previously with the "Discovery's," thus enabling a comparison of the instruments of the two exploring vessels to be made.

The report concludes with a letter from the auxiliary station at Kerguelen which was established by Herr Enzensperger on the shores of Royal Sound in November, and was visited by the "Gauss" on her way southward in January, 1902; but the letter had been dispatched some weeks before the ship arrived.

We miss any detailed account of the meteorological work of the expedition, or particulars as to the placing and working of the various self-recording instruments on board.

It is impossible to overrate the importance of preliminary work in comparatively easy conditions before grappling with the manifold difficulties of the polar seas. Indeed, we believe that those who organize polar expeditions for scientific work would be well advised to insist on a preliminary trip of at least three months' duration before the final plans and equipment are settled. The result would not be waste of time; it would render fruitful a vast amount of work which without preliminary experience is sure to be wasted. In this respect Antarctic expeditions are more advantageously situated than those of the Arctic regions, where the ship is in the midst of its field of work before the men have settled down to life on board and to work under the countless limitations which harass the man of science at sea. H. R. M.

FORESTRY IN SAND HILLS.

To make a desert productive by growing forests where probably no trees ever grew before, to modify climate and protect field crops by checking the hot winds which wither and destroy, to place within convenient reach of a rich agricultural country a cheap and permanent source of timber supply—these, says a writer in the New York Times, are the results which the Bureau of Forestry confidently expects to secure by the work it has just begun in the sand hill country of Nebraska. The President recently put his approval on the scheme by declaring 211,000 acres of the public lands of Nebraska forest reserves. Two reserves were created—one, called the Dismal River Reserve, between the Dismal and Middle Loup rivers, with 86,000 acres; the other, the Niobrara Reserve, with 125,000 acres, between the Niobrara and Snake rivers. The division of tree planting of the Bureau of Forestry has now its experts in the field selecting suitable places for forest nurseries and plantations. In a few years thousands of acres of trees will have been set out, and forests created by artificial methods will have begun their struggle for life in one of the great deserts of the Middle West.

The Nebraska work marks an advance in forest policy in America, and a very important one. Hitherto the government has been content to acquire and administer lands which were already wooded. But in undertaking the Nebraska work the bureau has declared its policy of growing forests as well as administering those which already exist; it has undertaken the task of creating sources of timber supply on land that cannot profitably grow field crops. If the undertaking succeeds, or even if it shows in the next few years the proof of its ultimate success, its result is sure to be manifested in the creation of more reserves in the prairie lands of the Middle West and the planting of forests on a far larger scale. The sand hill country occupies about a third of Nebraska, and lies in the center of the State. Geologists believe the country was once the bed of an inland sea whose sandstone deposits under the wearing influence of the prevailing northwest winds have crumbled into sand and been heaped up in drifts and mounds. The sand hills have been piled at right angles to the wind, that is, from southwest to northeast, and this is the course taken by the rivers which flow through the country. It is the general belief that a great underground flow of water passes through the sand hills and drains the entire area. It has often been observed that no matter how dry the season may have been or how long the hot winds may have been blowing, the sand only a few inches beneath the surface is always moist.

Trees with roots long enough to penetrate into the damp rich soil find abundant nourishment, and thrive accordingly. The bull pine has a long tap root, which goes down straight as a plumb to the wet sand beneath. However scanty the rainfall, this tree is secure from drought by reason of its store of moisture under ground. The Bureau of Forestry has planned to plant up the sand hill reserves gradually with trees by making small plantations of 4 or 5 acres in the most favorable parts of the country, and gradually extending them until they ultimately merge together in a continuous forest. Thus widespread mistakes will be avoided, and the conduct of one plantation will affect the treatment of the rest. The forest planting in the sand hill country is watched with friendly interest by the people of Nebraska, who feel confident of its success, now that the government is behind it. The work means much to them, for if it succeeds on the limited area included in the forest reserves, it should succeed anywhere in the fifteen millions of acres of unproductive land in the entire sand hill country and thus increase tremendously the value of a third of the State's area.

THE JOURNEYING OF BIRDS.

It is now abundantly established that migration is mostly carried on at night and, further, mainly during clear nights. Only a comparatively few species, such as ducks, cranes, certain large hawks, swallows, swifts, and nighthawks, migrate during the daytime, and these, it will be observed, are either rapacious birds or mainly those that enjoy such power of rapid flight as to be relatively safe from capture. All the vast horde of warblers, sparrows, finches, flycatchers, thrushes, and woodpeckers, as well as many waders and swimmers, migrate at night. On clear, still nights during the migrations birds may often be heard calling to each other high over head, and may be actually seen by powerful telescopes. Woods and hedgerows that were untenanted one day may become fairly alive with birds at daylight the next morning, showing that they have arrived during the night. They remain to feed and rest during the day, and if the weather be favorable, may practically all disappear the next night. That they only venture on these journeys during clear nights is shown by the fact that on such nights very few birds are killed by lighthouses, monuments, or other obstructions, whereas on cloudy or rainy nights, especially such as opened clear and later become overcast, thousands of birds become confused and dash themselves against these obstructions. Thus over 1,500 birds have been found dead at the base of the Bartholdi statue in New York Harbor in a single morning, and 230 birds of one species—black poll warblers—were killed in a single night (September 30, 1883), by the Fire Island Light. The Washington Monument, although not illuminated at night, causes the death of hundreds of birds annually.—The Popular Science Monthly.

SELECTED FORMULÆ.

Insect Destroyers.—As the warm weather approaches insects become more numerous. Roaches seem to thrive well even in winter, protected by the modern steam-heated houses, but they have a better chance of flourishing in summer. Flies, though, are mainly a summer product, and with them and other like pests we have to contend:

For roaches, a poison which is practically harmless to man may be made by the following formula:

Borax	9 ounces
Starch	2½ ounces
Cocoa	1 ounce

Another preparation not so inactive as to human beings is made by mixing:

Angelica root, in fine powder	5 ounces
Oil of eucalyptus	1 ounce

Scatter at night plentifully around the haunts of the pests.

The well-known insect powder obtained by grinding the flowers of certain pyrethrums is also an excellent agent for the destruction of roaches, but not quite so convenient to use as the foregoing. The observations of some experimenters seem to show that the poisonous principle of these flowers is non-volatile, but our experience indicates that these observations are not complete, as the most favorable conditions under which to use them are in a room tightly closed and well warmed. There may be two poisonous principles, one of which is volatile. Disappointment sometimes arises in its use from getting powder either adulterated, or which has been exposed to the air and consequently lost some of its power. When a good article is obtained and used plentifully under the conditions above indicated, it proves very efficient.

An objection to the foregoing method is the great dust which it makes. This dust sometimes proves irritating to the mucous membranes of the one applying the powder, and also makes a "mess" in the room. To avoid this, it has been made into a tincture and applied by means of a spray atomizer, with alleged good results.

We would add that persistence in the use of any means is an important element in the work of destroying roaches. A given poison may be employed and no visible result follow at first, when in reality many bugs may have been destroyed, enough being left to deceive the observer as to numbers. They multiply very rapidly, too, it must be remembered, and vigorous work is required to combat this increase. Where they can easily migrate from one householder's premises to those of another, as in city "flats," it requires constant vigilance to keep them down, and entire extermination is scarcely to be expected.

A fly poison which is harmless to man may be made from quassia wood as follows:

Quassia	1,000 parts
Molasses	150 parts
Alcohol	50 parts
Water	5,750 parts

Macerate the quassia in 500 parts of water for 24 hours, boil for half an hour, set aside for 24 hours, then press out the liquid. Mix this with the molasses and evaporate to 200 parts. Add the alcohol and the remaining 750 parts of water, and without filtering, saturate absorbent paper with it.

This being set out on a plate with a little water attracts the flies, which are killed by partaking of the liquid.

Insect powder is said to be an effective destroyer of ants, as it is of beetles. Ground mustard accidentally spilled on the floor of a pantry and allowed to remain for some time drove ants away. Sulphur is said to prove similarly distasteful to them. Oil of cedar and coal oil also drive them away. Borax would probably prove fatal to ants, if they could be induced to eat it. This might be accomplished by mixing it with sugar; or they might be attracted by the cocoa mixture, a formula for which is given above.

Where ants select a particular point for their incursions it would be a good plan to surround it with a "fortification" of obnoxious substance. Sulphur, mentioned above as being distasteful to them, has been used successfully in this way, we are told; and so has coal oil. The latter, however, is not a desirable agent, leaving a persistent stain and odor.

In the extermination of ants, as of roaches, persistence is a factor of great value, and failure of agents which have proved useful elsewhere may be due to a want of this factor.—Drug. Circ. and Chem. Gaz.

Toning Photographs.—Black toning of photographs is secured by the use of platinum. A comparatively new platinum bath is made from phenylene-diamine and chloroplatinite of potassium. The reducing action of the phenylene-diamine causes metallic platinum to be on the verge of deposition, and thus in a suitable condition for a toning bath. The formula is:

Phenylene-diamine (1 per cent sol.)	5 to 10 c.c.
Potassium chloroplatinite (1 per cent sol.)	5 to 10 c.c.
Distilled water	100 c.c.

Matt surface papers are very satisfactorily toned with this, the tones given being intense platinum blacks.

Whether this will work to advantage on the brand of paper mentioned we do not know; if not the manufacturer of the paper would doubtless be willing to give advice.—Drug. Circ. and Chem. Gaz.

Colors for Pomade.—Pomade may be colored red by infusing alkanet in the grease; yellow may be obtained by using anatto in the same way; an oil-soluble chlorophyl is obtainable in the market which will give a green color by admixture.

In coloring grease by means of alkanet or anatto it is best to tie the drug up in a piece of coarse cloth, place in a small portion of the grease, heat gently, squeezing well with a rod from time to time; and then adding this strongly-colored grease to the remainder. This procedure, it will be noticed, obviates exposing the entire mass to heat, and neither decantation nor straining is needed.—Drug Circ. and Chem. Gaz.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Drugs and Druggists' Supplies in Chile.—Most of the crude drugs imported into Chile come from England and Germany. Dealers claim that the American products are too high in original cost and in expense of transportation.

Nearly all tinctures and fluid extracts are made in Chile, on account of the cheapness of alcohol. A large per cent of the compound drugs used in this country are of London make, but considerable quantities are compressed by the local druggists. The tendency is to manufacture everything possible in the way of drugs in the country, so as to secure greater profits and at the same time supply the trade at reasonable prices, as a majority of the people are very poor and economy is a necessary consideration.

Patent medicines of American origin, generally considered, are in very good demand; but this demand can be maintained only by constant and judicious advertising.

The consumption of chemicals in Chile is increasing, on account of the advance in industrial interest and the growth of manufactories; but very little of the present supply comes from the United States, in comparison with what is imported from Germany. Sulphuric acid mostly comes from Germany; soda and its salts, from England.

American drug sundries have considerable consumption in Chile, especially rubber goods and hose. Most of the glassware used in the drug business in this country is of German, French, and English origin, the importance of the importations being in the order named. The glassware that comes from the United States is heavier, and consequently dearer, duties being paid on weight. The market in Valparaiso in this line of goods is practically controlled by one or two houses.

Drug store fixtures are mostly manufactured in the country. There are many good woods and very good workmen in this line in Chile. The duties on furniture make the importation of that article practically prohibitory.

Soda fountains are very rare in Chile. There is but one now in use in the city of Valparaiso, and Messrs. Griffith & Co., who have it in their drug store, inform me that it is practically valueless, as there is no demand for soda water here.

There is a constant demand for fancy soaps of well-known brands; also for perfumes and toilet waters of high grades. A considerable per cent of this trade goes to the United States.

American surgical appliances, more especially rubber plasters, are largely used in Chile.

The majority of photographic and optical goods used here come from Germany, France and England, in the order named. But in photographic supplies especially the United States is becoming a strong competitor.

Foods and alimentary products used in Chile come largely from England, and are of the patent variety, though Germany sends some of this class. Large quantities of canned goods and preserved and cured meats of United States manufacture are consumed in the Chilean market.

Artificial limbs are mostly manufactured in the country—in a small way, however, as the demand for such articles is practically nil. The poorer classes are content with the crudest apologies for artificial limbs, on account of the high price of the better articles.

Toilet and bathroom articles are mostly imported from Europe, but bathroom fittings come from the United States.

Much of the paint and oil comes from the United States, especially in the lighter grades, but the heavier lead and zinc paint materials come from England.

To sum up trade conditions in Chile briefly, it may be said that it is a cosmopolitan country, where the products of nearly all the industrial nations may be found. The drawback to large trade in general is found in the fact that it is a limited market, due to the small population, the unstable financial conditions, and the indefinite credits that are granted.—R. E. Mansfield, Consul at Valparaiso.

Bounties for Russian Shipbuilding.—The council of mercantile marine affairs has had under discussion measures to develop Russian shipbuilding. It is proposed to issue loans or bounties to shipowners to induce them to build ships at home rather than have them built abroad and to stimulate the purchase of Russian ships built of Russian material. This will be accomplished by a mortgage on the completed vessel at 50 per cent of the actual cost, without interest, for a period not exceeding twenty years, in equal yearly payments. The cost is ascertained by estimating the expense of building ships in Russia according to certain regulations. The amount of the bounty depends upon the difference between the cost of building ships in Russia and abroad. The loans are issued to seagoing steamships under the following conditions: (a) Plans and specifications of ships must be presented to the Minister of Finance; (b) the steamers must rank in the highest class, according to the British Lloyd's regulations; (c) the average speed of boats of over 1,000 tons register must not be less than 10 knots on six hours' trial; of under 1,000 tons, not less than 8 knots at Lloyd's lower load line.

To enable shipowners to repay the loans, two measures are proposed: First, the loans will be on long time—twenty years—without interest; second, the government will bear part of the expense of insurance. To facilitate the export of Russian goods by steamers built in Russia, it is proposed to allow a rebate of half the expense for Russian coal used on all steamers carrying less than three-fourths of a full cargo on export and one-half on import.

It is estimated that the unavoidable drafts on the government treasury by these plans to foster home shipbuilding will not be so large as they would be by payment of direct navigation and shipbuilding premiums.

The regulations are discussed at length, and they were considered ready to be sanctioned by the government council, but it was decided that the entire project must first be published in the press of the Empire for remarks, criticisms, or suggestions from persons interested. This is done on account of the diversity of interests involved.

Meanwhile, to supplement this plan, all Russian merchant ships will be registered and a comparative statement of methods of navigation in Russia and abroad will be compiled.—R. T. Greener, Commercial Agent at Vladivostock.

Plows in China.—North China, Mongolia, Manchuria, and that part of Siberia bordering on the Pacific are destined soon to become consumers of American agricultural implements. The greater part of this country is susceptible of cultivation. The production of wheat is already a leading industry in various localities. It is carried on without the use of any modern machinery; but in spite of these crude methods, the wheat usually sells at about one-half the price in the United States, and the natives would increase the production by millions of bushels for the price of 30 cents per bushel delivered at mills.

There are several reasons why I consider this territory a good field for marketing agricultural implements. First, the country is not, as a rule, thickly populated; this is especially true of Mongolia, Manchuria and Siberia. Laborers are imported each season to assist in planting and harvesting crops. There exists, therefore, more of a disposition to save labor than is generally found in other parts of China. Second, all of this country is abundantly supplied with animal power. Ponies, mules, donkeys, and cattle are used in every way to relieve the burdens of men. There are few parts of the world where animal power is more generally used than here. Plows, harrows, rollers, carts, and various other crude machines, locally made, are in constant use. The hand tools and the methods in use in other parts of China for cultivating, harvesting, and marketing crops are not so extensively employed here. As the people are so well trained in the use of this animal power and already use many crude machines, there will not be serious difficulty in introducing better appliances. Third, the country is generally cultivated in much larger fields than in middle and southern China, and the employment of improved machinery would involve no change in the nature of their industry. Fourth, the opening of the country by railroads will reduce the cost of getting products to markets and at the same time increase the supply.

While these more general features are conducive to the introduction of agricultural machinery, it must not be understood that there are no difficulties.

The expansion of Russia and the advent of Russians in Siberia, Mongolia and Manchuria will have a tendency to enlarge the use of machinery; but for an immediate market it is necessary to overcome the natural conservatism of the Chinese. About twenty years ago an Englishman brought two plows here. He tried to sell them and could not; he endeavored to give them away, but no one would take them; then he made an effort to get someone to experiment with them, but he could not even get a man to hitch a team to one.

A more recent experiment was the introduction from the United States of plows of the type used in Hindostan. The general form of this plow—with a single upright handle, similar to the native plow—it was thought would make it acceptable; but, unfortunately, it had a long beam and was designed to be attached to a yoke over the animal's neck, and so it proved a failure.

Above all other considerations, the plow must be cheap—as cheap as it is possible to make it, and so cheap that it would not be used in the United States. The form must differ very little from that now in use by the natives—short beam, single handle, and as simple of construction as possible.

The value of an improved plow will, I think, lie in deeper plowing with the same power. This would have to receive practical demonstration in every hamlet, and care should be taken to avoid some superstition, which might be done by giving the plow a favorable name.

An expert should be sent to the country to investigate all the conditions and the plow should be designed to meet them.

The market, if secured and cultivated, will receive millions of plows. Oregon fir is suitable for the woodwork of the plows, and if the iron part can be produced cheaply upon the Pacific coast the plow could no doubt be made there best.

The only iron about the implement is a long point that turns down to enter the ground. There is also another form of point, wider and shorter, that very much resembles that of the shovel plow. These points are cast in considerable quantities in the seaports from scrap iron that is imported. They are light, inferior articles and cost from 20 to 30 cents each.

Blacksmiths with wheelbarrows loaded with tools, bellows, casting molds, etc., go among the interior villages every spring, to make and renew the plows. The farmers pay 15 or 20 cents for a new plow point made from their own old iron.

In northern Manchuria, near Harbin, where there are several modern flour mills, better plowing is done and from three to five mules or ponies are hitched to each plow. It is at this point that I think the effort to introduce the plow would be most successful, and threshing and cleaning mills would also be most easily introduced here.

Kao-liang, or tall millet, is extensively grown throughout this country. It is threshed in the following manner: The heads are cut off, spread on the floor and threshed by means of a stone roller, to which an ox or mule is harnessed. The separation of the grains from their cases is completed in about four hours. The empty heads are then removed, either to be burned as firewood or to be made into brooms, and the grain is swept up and passed through a winnowing machine or tossed into the air, where the wind catches and removes the dust. The grain is now ready to be packed into sacks for market, but it has still to be husked before it can be used for human food. It is given to animals in its unhusked state. To remove the husks the grain is spread on a circular stone platform and crushed by a revolving stone roller. The whole is then passed through a winnowing machine.

The vast area of splendid soil for grain production, the reliability of climatic conditions that make crop failures and famine most uncommon, the nearness of the country to the Pacific Ocean, the development of railways and the frugal, industrious habits of the people all promise a great increase in wheat and grain production, and make this an inviting market for agricultural machinery.

The field should be carefully studied, and, in order to satisfy the prejudices of the people and create a market, implements should be designed especially for this territory.—Henry B. Miller, Consul at Niuchwang.

Manchurian Flour.—A committee of the local board of trade gives some details of the Manchurian flour market. Wheat in Manchuria sells at 25 to 30 kopecks (12.8 to 15.4 cents) per pood (36.112 pounds). One pood of wheat yields 67 per cent of flour of the first quality. The flour costs in Manchuria about 45 kopecks (23 cents) and freight 35 kopecks (18 cents) per pood—total, 80 kopecks (41 cents), delivered at this market. Russian wheat costs from 80 to 85 kopecks (41 to 43.7 cents) per pood, and the best flour from this would cost not less than 1.30 rubles (67 cents) per pood; hence, Manchurian flour is cheaper than Russian wheat.

There are twelve private steam flour mills in the South Ussuri district, besides a number operated by water. The largest one cost 300,000 rubles ($154,500). It is situated at Nikolsk-Ussurisk and has an estimated capacity of 1,800,000 poods (65,001,600 pounds) annually. The other eleven are also worked by steam; estimated capacity, 600,000 poods (21,667,200 pounds) yearly. Five are situated at Nikolsk; six in different parts of the district.

At Harbin there are two steam flour mills at work. The Chinese Eastern Railroad Company paid 150,000 rubles ($75,250) for one. One mill has a capacity of 3,500 poods (126,392 pounds) daily; it is proposed to raise this to 7,000 poods (252,784 pounds), and to open a macaroni department. The other mill, with a capacity of 600 poods (21,667 pounds) daily, belongs to a company which has been operating it for two years. Its capacity is also to be increased. New engines and modern appliances are ordered. Both mills are excellently situated on the banks of the Soongaree, a short distance from the railroad. It is predicted that the output of these mills will drive out American flour, and will soon supply the entire commissary department.

The Chinese merchants sell American flour cheaper than do the Siberian merchants. The explanation given is that a bag of flour is supposed to weigh 54 to 55 pounds, but the Chinese merchants are said to deliver only 50 pounds to the bag.—R. T. Greener, Commercial Agent at Vladivostock.

Promotion of Cotton-Goods Industry in Mexico.—The Congress of the Republic of Mexico recently passed an act which will serve to promote the cotton industry of this country. The numerous railroad enterprises under way will provide manufacturers with new transportation facilities, and steps will be taken to enable them to make shipments direct from plant and on through bills of lading over existing roads and others now in course of completion, at rates that will enable the native manufacturer to successfully compete with foreign imports.

The following is an abstract of the above-mentioned act, dated June 6, 1902:

"The Executive of the Union is empowered, and it remains optional with him, to return all, or a part of, the internal revenue tax collected in conformity with the decree of November 17, 1893, in all cases where woven cotton goods are exported through custom-houses of the Republic for use or consumption in foreign countries.

"The Executive is also empowered to grant exporters of woven cotton goods of native manufacture a drawback in a sum not exceeding 8 cents per kilogramme (2.2046 pounds) net on all import duties, port charges, and additional duties that may have been collected on the imports of raw cotton from foreign countries, which raw cotton has been manufactured into woven cotton goods.

"Cotton Goods.—All woven cotton goods of native manufacture that may have been exported under the stipulations expressed in the foregoing article may be reimported in conformity with regulations of article II. of the custom-house regulations. In such case, however, the amount of drawback which may have been allowed by the government must be refunded to the treasury at time of reimportation of said woven cotton goods."—William W. Canada, Consul at Veracruz.

A New Invention.—The Frankfort Review describes a new invention in the line of straw hats made of paper. This hat can be got up so cheap as to afford a handsome profit on the retail selling price of 10 cents. The hat is to look exactly like straw, is impervious to rain, very light in weight, and having a wire inside padding will not be subject to creasing or breaking. The invention is patented and the patent rights have been purchased by the Société Lumière, Lyons, France, to whom any applications from would-be purchasers should be addressed.—Simon W. Hanauer, Deputy Consul-General.

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No. 1433. September 2.—* Plows in China—* Manchurian Flour.

No. 1434. September 3.—German Consumption of Fresh and Preserved Fruits.

No. 1435. September 4.—Cotton-goods Trade in Cuba—Marble and Marble Products in Hungary—German Export of Locomotives and Traction Engines—Meat Inspection Expenses in Germany.

No. 1436. September 5.—New Food Plants in Yucatan—Development of German Cable Lines—Exposition of German Articles at Barcelona.

No. 1437. September 6.—The Manchurian Railway—Economic Conditions in Germany—Camphor Monopoly in China.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECIPES.

Clothes Cleaners.—When the fabric is washable and the color fast, ordinary soap and water are of course efficient in removing grease and the ordinarily attendant dirt; but special soaps are made for clothes cleaning which may possibly be more effective.

We here reprint several formulas for such preparations:

I.

Powdered borax	30 parts
Extract of soap bark	30 parts
Oxgall (fresh)	120 parts
Castile soap	450 parts

First make the soap bark extract by boiling the crushed bark in water until it has assumed a dark color, then strain the liquid into an evaporating dish, and by the aid of heat, evaporate it to a solid extract; then powder and mix it with the borax and the oxgall. Melt the castile soap by adding a small quantity of water and warming, then add the other ingredients and mix well.

About 100 parts of soap bark make 20 parts of extract.

II.

Castile soap	2 pounds
Potassium carbonate	½ pound
Camphor	½ ounce
Alcohol	½ ounce
Ammonia water	½ ounce
Hot water, ½ pint, or sufficient.	

Dissolve the potassium carbonate in the water, add the soap previously reduced to thin shavings, keep warm over a water bath, stirring occasionally until dissolved, adding more water if necessary, and finally, when of a consistence to become semi-solid on cooling, remove from the fire, and when nearly ready to set, stir in the camphor, previously dissolved in the alcohol, and the ammonia.

The addition of the last named drugs is probably a survival of "shotgun" practice in making mixtures. The soap will apparently be quite as efficacious without them.

If a paste is desired, a potash soap should be used instead of the castile in the foregoing formula, and a portion or all of the water omitted. Soaps made from potash remain soft, while soda soaps harden on the evaporation of the water which they contain when first made.

A liquid preparation may be obtained, of course, by the addition of sufficient water, and some more alcohol would probably improve it.

A strong decoction of soap bark, preserved by the addition of alcohol, would also form a good liquid cleanser for fabrics of the more delicate sort.

Gloves if not too much soiled may be cleaned by rubbing with fuller's earth.—Drug. Circ. and Chem. Gaz.

New Coating or Mineral Paint, Fireproofing, Antiseptic and Resistive to Acids.—This paint is insoluble, adhering to all bodies and able to support changes of weather, repeated washings, and even acids. It also forms on the surfaces on which it is applied a very hard coating of stone, though not completely vitreous, having more or less porosity. It may be brushed over or polished exactly like lacquer or marble.

It is readily produced and applied in the following manner: Mix with a solution of alkaline silicate, varying from 20 to 30 deg. Bé., the degree varying according to the measure of adherence to be obtained, the powder which may serve both for the conversion of this silicate and the formation of an oxychloride, as, for example, magnesium oxide, in sufficient quantity to obtain the desired coat, light or thick, according to the quantity incorporated, which for this reason cannot be determined exactly. It may be said, however, that the quantity of the converting element ought not to be less than a third in volume of the alkaline silicate employed.

A paint is thus obtained, pliant and capable of being spread either with a brush or otherwise over the surface to be covered. The hardening and desiccation is produced after more or less time, according to the temperature, but should not be hastened. Afterward, the imbibition of the layer thus applied is effected either with chlorhydric acid of about 10 deg. Bé or with magnesium chloride of about 20 deg.

The portion of magnesium oxide not combined with the alkaline silicate is thus penetrated with the second liquid, which converts it in a few hours into magnesium oxychloride, rendering the entire coat insoluble, the hardness of which is also increased by this second application.

The porosity may be augmented by the addition (about 10 grammes per liter of the alkaline silicate) of gelatinous silica or of gelatinous silicates or fluosilicates, as finely divided as possible. Several coats may be applied in this way in succession.—La Revue des Produits Chimiques.

Substitute for Varnish.—A substitute for varnish is produced, according to Ammundsen, by adding to 100 parts of caseine, 10 to 25 parts of a 1 to 10 per cent soap solution and then 20 to 25 parts of slaked lime. The mixture is carefully kneaded until a perfectly homogeneous mass results. Then gradually add 25 to 40 parts of turpentine oil and sufficient water for the mass to assume the consistency of varnish. If it is desired to preserve it for some time a little ammonia is added so that the caseine-lime does not separate.

The surrogate is considerably cheaper than varnish and dries so quickly that paint ground with it may be applied twice in quick succession.—Chemiker Zeitung.

Varnish for Locksmith's Work.—A good varnish for various metal articles, window angles, etc., is prepared by melting together in an iron pan: West Indian copal 30 parts, natural asphalt 5 parts, American pine resin 5 parts, coal-tar pitch 5 parts, Venice turpentine 1 part and wax 1 part. The molten mass should be stirred until it runs evenly from the spatula. Then add turpentine oil 6 parts, linseed oil varnish 2 parts and rosin oil 2 parts and allow the mass to cool off. Finely dilute the mixture with petroleum benzine until of the consistency necessary to apply it.—Neueste Erfindungen und Erfahrungen.

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